WISMO Quik Q2400 series

Q2403 Product Specification

Reference: **WM_PRJ_Q2400_PTS_001**
Revision: **003**
Date: **6th November 2002**

Document Information

Revision	Date	History of the evolution	
001	Sept 2001	Creation as "Preliminary"	
002	July 2002	"Preliminary" mention removed but GPRS consumption is still TBD	
003	November 2002	IMP connector removed from the PTS GPRS consumption confirmed (§ 2.2.2) Physical characteristics confirmed (§ 3.3.1)	

Overview

This document defines and specifies the WISMO QUIK Q2403 Series, available under two GSM/GPRS Cl.2 versions:

- **Q2403A**: EGSM/GPRS **900**/**1800** MHz version with **16** Mb of Flash memory and **2** Mb of SRAM (16/2)
- **Q2403B**: EGSM/GPRS **900**/**1800** MHz version with **32** Mb of Flash memory and **4** Mb of SRAM (32/4)

Contents

Caution

Information furnished herein by Wavecom are accurate and reliable. However no responsibility is assumed for its use. Please read carefully the safety precautions for a terminal based on WISMO Quik Q2403 Series.

General information about Wavecom and its range of products is available at the following internet address: http://www.wavecom.com

Trademarks

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1 General description

1.1 General information

WISMO Quik Q2403 is a self-contained E-GSM/GPRS 900 / 1800 dual band module including the following features:

- 58.3 x 32.2 x 3.9 mm
- 2 Watts EGSM radio section running under 3.6 Volts
- 1 Watt GSM1800 radio section running under 3.6 Volts
- Digital section under 2.8 Volts
- 3V SIM interface
- Real Time Clock with calendar
- Battery charger
- Echo Cancellation + noise reduction
- Full GSM or GSM/GPRS software stack
- Hardware GPRS class 2 capable
- Complete shielding
- Complete interfacing
- Power supply
- Serial link
- Audio
- SIM card
- Keyboard
- LCD (not available with AT commands)

WISMO Quik Q2403 Series has two external connections:

- RF connection pads (to the antenna)
- General Purpose Connector (GPC) to Digital, Keyboard, Audio and Supply

WISMO Quik Q2403 Series is designed to fit in very small terminals and only some custom functions have to be added to make a complete Dual Band solution:

- Keypad and LCD module
- Earpiece and Microphone
- Base connector
- Battery
- Antenna switch
- SIM connector

1.2 Functional description

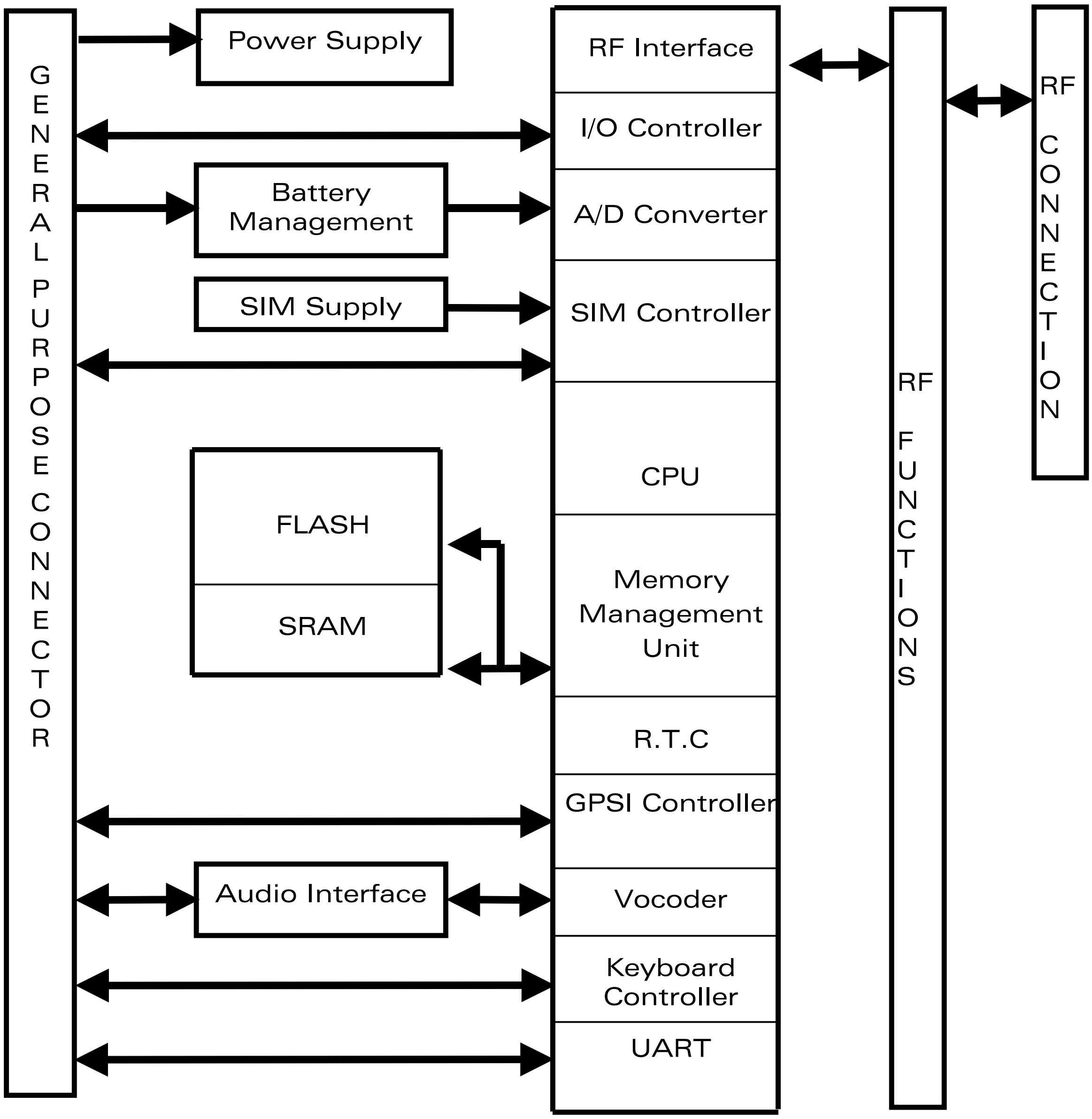


Figure 1 : Functional architecture

1.2.1 RF functionalities

The RF functionalities comply with the Phase II EGSM 900/GSM 1800 recommendation. The frequencies are:

- Rx (EGSM 900): 925 to 960 MHz Rx (GSM 1800): 1805 to 1880 MH
- Tx (EGSM 900): 880 to 915 MHz Tx (GSM 1800): 1710 to 1785 MHz

The RF part is based on a specific dual band chip including:

- Low-if Receiver
- Dual RF synthesizer
- Digital if to Baseband Converter
- Offset PLL transmitter
- 1 (logarithmic) PA controller
- Dual band PA module

1.2.2 Baseband functionalities

The digital part of the WISMO Quik Q2403 Series is composed of a PHILIPS-VLSI chip (ONE C GSM/GPRS Kernel). This chipset is using a 0,25 μm mixed technology CMOS, which allows massive integration as well as low current consumption.

1.3 Firmware

WISMO Quik Q2403 Series is designed to be integrated into various types of applications such as handsets or vertical applications (telemetry, multimedia, automotive,...).

For vertical applications, the firmware offers a set of AT commands to control the module. With this standard software, some interfaces of the module are not available since they are dependent on the peripheral devices connected to the module. They are the LCD interface and the SPI bus.

2 Interfaces

2.1 General Purpose Connector (GPC)

A 60 pins connector[1] is provided to interface the WISMO Quik Q2403 Series with a board containing either a LCD module, or a keyboard, or a SIM connector, or a battery connection…

The interfaces available on the GPC are described in the next paragraphs.

☞ Please be aware that some of these interfaces can not be handled when using the WISMO Quik Q2403 Series driven by AT commands: LCD interface, SPI bus.



This symbol is used to indicate the interfaces not available with AT commands.

These functions have then to be managed externally i.e using the main processor of the application.

[1] The communication interface connector is a 60 pins connector with 0.5mm pitch from KYOCERA / AVX group with the following reference (see chapter connectors reference for further details):

14 5087 060 930 861.

The matting connector has the following reference :

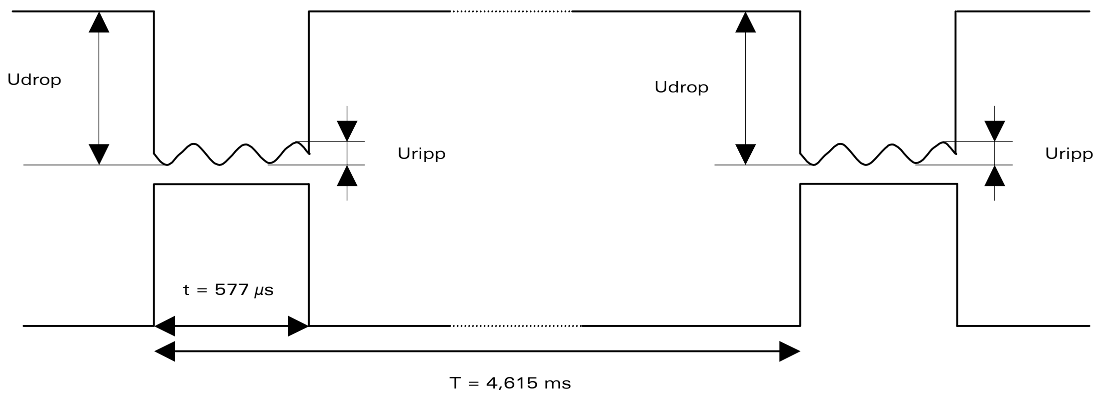
24 5087 060 X00 861.

2.2 Power supply

2.2.1 Power supply description

The power supply is one of the key issues in the design of a GSM terminal. Due to the burst mission in GSM / GPRS, the power supply must be able to deliver high current peaks in a short time. During these peaks the ripple (U_{ripp}) and the drop (U_{drop}) on the supply voltage must not exceed a certain limit.

In transmission mode, a GSM/GPRS class 2 terminal emits (1Tx) 577µs radio bursts every 4.615ms.



Two different inputs are provided for the power supply. The first one, VBATT is used to supply the RF part and VDD, the second one is used to supply the baseband part.

Note:

- It is possible to connect VBATT to VDD.
- In case of separate power supplies, they have to be in the same state (ie. both active or inactive at the same time).

VBATT: supplies directly the RF components with 3.6 V. It is essential to minimize the voltage ripple at this connection in order to avoid any phase error. The RF Power Amplifier current (2.0A peak in GSM /GPRS mode) flows with a ratio of 1/8 of the time, around 577µs every 4.615ms for GSM /GPRS cl 2. The rising time is around 10µs.

VDD: supplies the +2.8V ballast regulators of the WISMO Quik Q2403 Series. It is essential to keep the voltage over 3.1 volts.

The WISMO Quik Q2403 Series shielding case is the grounding. The ground has to be connected on the mother board through a complete layer on the PCB.

Power Supply Voltage

	V_{MIN}	V_{NOM}	V_{MAX}	Ripple max
VBATT	3.3 V (*)	3.6 V	4.5 V (**)	50 mVpp for freq<200kHz 2 mVpp for freq>200kHz
VDD	3.1 V		4.5 V	100 mVpp

(*): This value has to be guaranteed during the burst (with 2.0A Peak in GSM or GPRS mode)
(**): max operating Voltage Stationnary Wave Ratio (VSWR) 2:1

When supplying the module with a battery, the total impedance (battery+protections+PCB) should be <150 mOhms

2.2.2 Power consumption

Following information are given assuming a 50 Ω RF output.

Power consumption in OFF mode

(module supplied, OFF state, no software running)

	Conditions	I_{NOM}	I_{MAX}
Overall consumption	Off	5 µA	10 µA

Power consumption in EGSM/GPRS 900 MHz (GPRS class 2)

	Conditions	I_{NOM}	I_{MAX}
VBATT	During TX bursts @ PCL5*	1.7 A peak	2.0 A peak
VBATT	During RX bursts	75 mA peak	80 mA peak
VBATT	Average 1Rx/1Tx@PCL5*	220 mA	260 mA
VBATT	Average Idle mode	100 µA	300 µA
VDD	Average TCH/FS mode	85 mA	100 mA
VDD	Average Idle mode (module in handset applications)	2.2 mA	2.7 mA
VDD	Average Idle mode (module driven by AT commands, UART running)	12 mA	16 mA

VDD	During RX bursts	50mA	60mA
Overall consumption	Average communication 1Rx/1Tx@PCL5*	265 mA	310 mA
	Average communication 1Rx/1Tx@PCL8*	190mA	210mA
	Average communication GPRS only 2Rx/1Tx@PCL5*	275 mA	320 mA
	Average Idle mode (module in handset applications)	2.3 mA	3 mA
	Average Idle mode (module driven by AT commands, UART running)	12 mA	16 mA

(*): PCL: Power Control Level.
PCL5: 2W emission requested (max.power)
PCL8: 0.5W emission requested

Power consumption in GSM/GPRS 1800 MHz (GPRS class 2)

	Conditions	I_{NOM}	I_{MAX}
VBATT	During TX bursts @ PCL0*	1.3 A peak	1.7 A peak
VBATT	During RX bursts	75 mA peak	80 mA peak
VBATT	Average 1Rx/1Tx@PCL0*	170 mA	220 mA
VBATT	Average Idle mode	100 µA	300 µA
VDD	Average TCH/FS mode	85 mA	100 mA
VDD	Average Idle mode (module in handset applications)	2.2 mA	2.7 mA
VDD	Average Idle mode (module driven by AT commands, UART running)	12 mA	16 mA
VDD	During RX bursts	50 mA	60 mA
Overall consumption	Average communication 1Rx/1Tx@PCL0*	215 mA	275 mA
	Average 1Rx/1Tx@PCL3*	150 mA	180 mA
	Average communication GPRS only 2Rx/1Tx@PCL0*	225 mA	285 mA
	Average Idle mode (module in handset applications)	2.3 mA	3 mA
	Average Idle mode (module driven by AT commands, UART running)	12 mA	16 mA

(*): PCL: Power Control Level.
PCL0: 1W emission requested (max.power)
PCL3: 0.25W emission requested

Power Supply Pinout

Signal	Pin number
VBATT	55, 57, 58, 59 60
VDD	11
GND	Shielding

The grounding connection is done through the shielding ⇨ the four legs have to be soldered to the ground plane.

2.3 Electrical information for digital I/O

All digital I/O comply with 3Volts CMOS.

Operating conditions

Parameter	I/O type	Min	Max	Condition
V_{IL}	CMOS	-0.5 V	0.8 V	
V_{IH}	CMOS	2.1 V	3.0 V	
V_{OL}	1X		0.2 V	I_{OL} = -1 mA
	2X		0.2 V	I_{OL} = -2 mA
	3X		0.2 V	I_{OL} = -3 mA
V_{OH}	1X	2.6 V		I_{OH} = 1 mA
	2X	2.6 V		I_{OH} = 2 mA
	3X	2.6 V		I_{OH} = 3 mA

To interface the WISMO Quik Q2403 Series digital signals with other logics:

- 3V logic: some serial resistors (between 2.2K and 4.7Kohms) can be added on the lines
- 3.3V logic: some serial resistors (between 4.7K and 10Kohms) can be added on the lines.
- For higher voltage logics, a resistor bridge or a level shifter IC can be added.

2.4 LCD interface

The WISMO Quik Q2403 Series can be connected to a LCD module driver through either a SPI bus or a two wires interface.

2.4.1 SPI bus

The SPI bus includes a CLK signal, an IO signal and an EN signal complying with SPI bus standard. The maximum speed transfer is 3.25Mb/s.

Pin description

Signal	Pin number	I/O	I/O type	Description
SPI_CLK	10	O	1X	SPI Serial Clock
SPI_IO	8	I/O	CMOS / 1X	SPI Data
SPI_EN	28	O	1X	SPI Enable

2.4.2 Two wires interface

The two wires interface includes a CLK signal and a DATA signal complying with a standard 96KHz interface. The maximum speed transfer is 400Kb/s.

Pin description

Signal	Pin number	I/O	I/O type	Description
SCL	10	O	1X	Serial Clock
SDA	8	I/O	CMOS / 1X	Data

2.5 SPI Auxiliary bus

A second SPI Chip Enable (called SPI_AUX) has to be used to add a SPI peripheral to the WISMO Quik Q2403 Series. The maximum speed transfer is 3.25Mb/s.

Pin description

Signal	Pin number	I/O	I/O type	Description
SPI_CLK	10	O	1X	SPI Serial Clock
SPI_IO	8	I/O	CMOS / 1X	SPI Data
SPI_AUX	26	O	1X	SPI Aux. Enable

2.6 Keyboard interface

☞ **Warning:**

This interface is not FULLY available with AT commands:

An AT command allows to get the input key code (see +CMER command description). This code has then to be processed by the application.

This interface provides 10 connections: 5 rows (R0 to R4) and 5 columns (C0 to C4).

The scanning is a digital one , and the debouncing is done in the WISMO Quik Q2403 Series. No discrete components like R,C (Resistor, Capacitor) are needed.

Pin description

Signal	Pin number	I/O	I/O type	Description
ROW0	13	I/O	CMOS / 1X	Row scan
ROW1	15	I/O	CMOS / 1X	Row scan
ROW2	17	I/O	CMOS / 1X	Row scan
ROW3	19	I/O	CMOS / 1X	Row scan
ROW4	21	I/O	CMOS / 1X	Row scan
COL0	23	I/O	CMOS / 1X	Column scan
COL1	25	I/O	CMOS / 1X	Column scan
COL2	27	I/O	CMOS / 1X	Column scan
COL3	29	I/O	CMOS / 1X	Column scan
COL4	31	I/O	CMOS / 1X	Column scan

2.7 Serial link

A flexible 6 wires serial interface is available complying with V24 protocol signalling but not with V28 (electrical interface) due to a 2.8 Volts interface.

The signals are Tx data (CT103/TX), Rx data (CT104/RX), Request To Send (CT105/RTS), Clear To Send (CT106/CTS), Data Terminal Ready (CT108-2/DTR) and Data Set Ready (CT107/DSR).

The set of RS232 signals can be required for GSM DATA services application and is generated by the general purpose I/O provided by the WISMO Quik Q2403 Series. The 2 additional signals are Data Carrier Detect (CT109/DCD) and Ring Indicator (CT125/RI).

Pin description

Signal	Pin number	I/O	I/O type	Description
CT103 / TX	39	I	CMOS	Transmit serial data
CT104 / RX	32	O	1X	Receive serial data
CT105 / RTS	30	I	CMOS	Ready To Send
CT106 / CTS	37	O	1X	Clear To Send
CT107 / DSR	36	O	1X	Data Set Ready
CT108-2 / DTR	34	I	CMOS	Data Terminal Ready
CT109 / DCD	51	O	CMOS / 2X	Data Carrier Detect
CT125 / RI	54	O	CMOS / 2X	Ring Indicator
CT102/GND	Shielding legs			Ground

The rising time and the falling times of the serial signals in reception (in particular CT103) have to be less than 200ns.

The minimum width of the reception signals (mainly CT03) have to be more than 2ms

Note:

The WISMO Quik Q2403 Series has been designed to be operated using all the serial signals. In particular, it is necessary to use the RTS/CTS hardware flow control signals in order not to lose data.

2.8 SIM interface

2.8.1 General Description

5 signals exist:

- SIMVCC: SIM power supply.
- SIMRST: reset.
- SIMCLK: clock.
- SIMDATA: I/O port.
- SIMPRES: SIM card detect.

The SIM interface controls a 3V SIM (and a 5V SIM through an external SIM driver). This interface is fully compliant with GSM 11.11 recommendations concerning SIM functions.

It is recommended to add Transient Voltage Suppressor diodes on the signal connected to the SIM socket in order to prevent any ElectroStatic Discharge. TVS diodes with low capacitance (less than 10pF) have to be connected on

SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edge. These types of diodes are mandatory for the Full Type Approval. They shall be placed as close as possible to the SIM socket.

The following references can be used: DALC208SC6 from ST Microelectronics.

Pin description

Signal	Pin number	I/O	I/O type	Description
SIMCLK	3	O	2X	SIM Clock
SIMRST	5	O	2X	SIM Reset
SIMDATA	7	I/O	CMOS / 3X	SIM Data
SIMVCC	9	O		SIM Power Supply
SIMPRES	50	I	CMOS	SIM Card Detect

Electrical Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
SIMDATA V_{IH}	I_{IH} = ± 20µA	0.7xSIMVCC			V
SIMDATA V_{IL}	I_{IL} = 1mA			0.3xSIMVCC	V
SIMRST, SIMDATA SIMCLK V_{OH}	Source current = 20µA	SIMVCC – 0.1V			V
SIMRST, SIMDATA SIMCLK V_{OL}	Sink current = -200µA			0.1	V
SIMVCC* Output Voltage	I_{SIMVCC} <= 6mA	2.70	2.80	2.85	V
SIMCLK Rise/Fall Time	Loaded with 30pF			50	ns
SIMRST, SIMDATA Rise/Fall Time	Loaded with 30pF			1	µs
SIMCLK Frequency	Loaded with 30pF			3.25	MHz

(*): given for the 3V interface. An external SIM driver is needed to handle 5V SIMs.

Note:

When not used **SIMPRES** has to be tied to VCC.

When used, a low to high transition means that the SIM card is inserted and a high to low transition means that the SIM card is removed.

2.8.2 SIM socket connection

SIM socket pin description

Signal	Pin number	Description
VCC	1	SIMVCC
RST	2	SIMRST
CLK	3	SIMCLK
CC4	4	VCC module
GND	5	GROUND
VPP	6	Not connected
I/O	7	SIMDATA
CC8	8	SIMPRES with 100kΩ pull down resistor

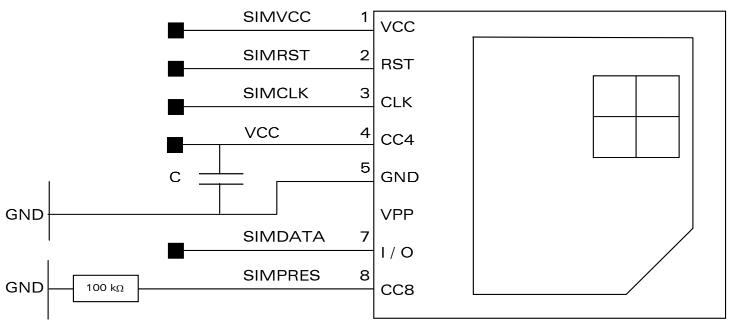


Figure 2 : SIM socket

The capacitor placed on the Sim Vcc must not exceed 470nF.

2.8.3 SIM 3/5V management

The WISMO Quik Q2403 Series module is designed to interface with 3V SIMs only[2].

Nevertheless, it is possible to manage 3V and 5V SIMs using an external level shifter (see application notes in appendix). In this case, depending on the type of SIM detected, the module firmware triggers the GPO0 output signal (pin #26) in order to properly set the external SIM driver level (3V or 5V).

[2] Most of the GSM operators have been providing 3V SIMs since 1998.

2.9 General Purpose Input/Output

The WISMO Quik Q2403 Series provides 6 General Purpose I/O, 3 General Purpose Outputs and 1 General Purpose Input. They are used to control any external device such as a LCD or a Keyboard backlight.

Pin description

Signal	Pin number	I/O	I/O type	Description
GPIO0	24	I/O	CMOS / 2X	General Purpose I/O
GPIO4	53	I/O	CMOS / 2X	General Purpose I/O
GPIO5	35	I/O	CMOS / 2X	General Purpose I/O
GPO1	22	O	3X	General Purpose O
GPO2	20	O	1X	General Purpose O
GPI	18	I	CMOS	General Purpose I

The following GPIOs are not available (reserved) in case of module running with the AT commands firmware:

Signal	Pin number	I/O	I/O type	Description	Comments
GPIO1	52	I/O	CMOS / 2X	General Purpose I/O	FLASH LED(*)
GPIO2	54	I/O	CMOS / 2X	General Purpose I/O	RI
GPIO3	51	I/O	CMOS / 2X	General Purpose I/O	DCD
GPO0	26	O	3X	General Purpose O	SIM 3V/5V

(*) The FLASH LED signal can be used to drive a LED through an open-collector transistor according to the module activity status.

<table>
<tr><th>LED status</th><th colspan="2">WISMO Quik Q2403 Series status</th></tr>
<tr><td>OFF</td><td colspan="2">Module in download mode or module OFF</td></tr>
<tr><td rowspan="3">ON</td><td>Permanent</td><td>Module switched ON, not registered on the network</td></tr>
<tr><td>Slow flash
LED ON for 200ms, OFF for 2s</td><td>Module switched ON, registered on the network</td></tr>
<tr><td>Quick flash
LED ON for 200ms, OFF for 600ms</td><td>Module switched ON, registered on the network, communication in progress</td></tr>
</table>

2.10 Analog to Digital Converter

Analog to Digital converter input is provided by the WISMO Quik Q2403 Series. This converter is a 10 bits one, ranging from 0 to 2.8V .

Pin description

Signal	Pin number	I/O	I/O type	Description
AUXV0	33	I	Analog	A/D converter

Electrical Characteristics

Parameter	Min	Max	Unit
Resolution	10		bits
Sampling rate	90.3		Ksps
Input signal range	0	2.8V	V
ADC Reference Accuracy	0.75	2	%
Integral Accuracy	+/- 1		LSB
Differential Accuracy	+/- 1		LSB
Input Impedance (R)	4.7		kΩ
Input Impedance (C)		100	nF

2.11 Audio interface

Two different microphone inputs and two different speaker outputs are supported.

The WISMO Quik Q2403 Series also includes an echo cancellation feature which allows handsfree function.

The MIC2 inputs already include the biasing for an electret microphone allowing an easy connection to a handset.

The MIC1 inputs does not include an internal bias. MIC1/SPK1 is then appropriate for a handsfree system or a handset with biasing exernal to the module.

2.11.1 Common microphone inputs characteristics

The connection can be either differential or single-ended but using a differential connection in order to reject common mode noise and TDMA noise is strongly recommended. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

Internal audio filter characteristics

Frequency	Gain
0-150 Hz	< -22dB
150-180 Hz	< -11dB
180-200 Hz	< -3dB
200-3700 Hz	0dB
>4000 Hz	< -60dB

The gain of MIC inputs is internally adjusted and can be tuned from 30dB to 51dB using an AT command.

Microphone gain vs Max input voltage

Transmit Gain (dB)	Max Vin (mVrms)	AT+VGT(*)
30	43.80	0 to 31
33	31.01	32 to 63
36	21.95	64 to 95
39	15.54	96 to 127
42	11	128 to 159
45	7.79	160 to 191
48	5.51	192 to 223
51	3.9	224 to 255

(*) control of the transmit gain by AT commands (for WISMO Quik Q2403 Series driven by AT commands)

Recommended characteristics for the microphone:

- 2V – 0.5mA
- 2 KOhms
- Sensitivity -40 to –50dB
- SNR > 50dB
- Frequency response compatible with the GSM specifications

For possible references, see chapter Connectors and peripheral devices references, §4.4.

2.11.2 Common speaker outputs characteristics

The connection can be differential or single-ended but using a differential connection to reject common mode noise and TDMA noise is strongly recommended. Morover in single-ended mode, ½ of the power is lost. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

Speaker outputs SPK2 are push-pull amplifiers and can be loaded down to 150 Ohms and up to 1nF (see details in table *Speaker gain vs Max output voltage).* These outputs are differential and the output power can be adjusted by step of 2dB. The output can be directly connected to a speaker.

2.11.2.1.1 Differential Connection

Impedance of the speaker amplifier output in differential mode:

- R ≤ 1Ω +/-10%

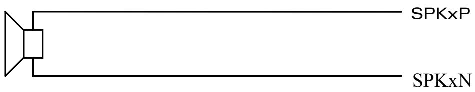


Figure 3: SPK outputs (single-ended connection)

2.11.2.2 Single-ended Connection

Typical implementation:

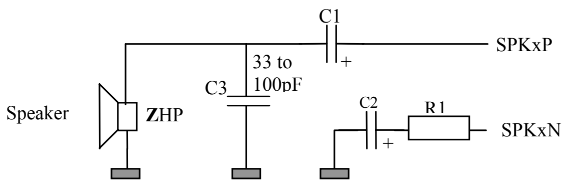


Figure 4: SPK outputs (single-ended connection)

C1 = from 4.7µF to 47µF as per the speaker characteristics and the output power.

C1=C2

R1= Speaker Impedance

Using a single-ended connection also includes losing half of the output power compared to a differential connection.

Nevertheless in a 32 Ohms speaker case, you should use a cheaper and smaller solution: R1 = 82 Ohm et C2 = 4.7µF (ceramic)

The gain of SPK outputs is internally adjusted and can be tuned using an AT command.

Speaker gain vs Max output voltage

Receive Gain (dB) (*)	Max output level (Vrms)	AT+VGR (**)	Max.speaker load (Ω)
+2	1.74	0 to 15	150
0	1.38	16 to 31	50
-2	1.099	32 to 47	32
-4	0.873	48 to 63	32
-6	0.693	64 to 79	32
-8	0.551	80 to 95	32
-10	0.437	96 to 111	32
-12	0.347	112 to 127	32
-14	0.276	128 to 143	32
-16	0.219	144 to 159	32
-18	0.174	160 to 175	32
-20	0.138	176 to 191	32
-22	0.110	192 to 207	32
-24	0.087	208 to 223	32
-26	0.069	224 to 239	32
-26	0.069	240 to 255	32

(*) analog gain: might not be significant

(**) control of the receive gain by AT commands (for WISMO Quik Q2403 Series driven by AT commands)

Recommended characteristics for the speaker:

- 150 Ohms[3]
- 10mW
- 110dB
- Frequency response compatible with the GSM specifications

For possible references, see chapter Connectors and peripheral devices references, §4.5.

[3] 32 Ohms for handsets

2.11.3 Microphone inputs

2.11.3.1 Microphone 2 Inputs

The MIC2 inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone 2 has to be around 2kΩ. These inputs are the standard ones for an handset design while MIC1 inputs can be connected to an external headset or a handsfree kit.

AC coupling is already embedded in the module.

Typical implementation:

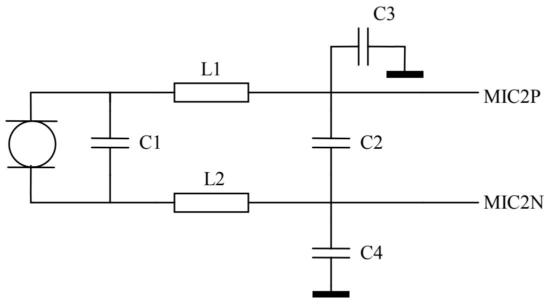


Figure 5 : MIC2 inputs (differential connection)

C1 = 10pF to 33pF

C2 = C3 = C4 = 47pF to 100pF

L1 = L2 = 100nH

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

C2 has to be very close to the WISMO Quik Q2403 Series connector.

L1, L2, C3 and C4 has to be put near the WISMO Quik Q2403 Series connector and can be removed according to their environment (ground plane, shielding, etc...). The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

Pin description

Signal	Pin #	I/O	I/O type	Description
MIC2P	46	I	Analog	Microphone 2 positive input
MIC2N	48	I	Analog	Microphone 2 negative input

2.11.3.2 Microphone 1 Inputs

The MIC1 inputs are differential and do not include internal bias. To use these inputs with an electret microphone, bias has to be generated outside the WISMO Quik Q2403 Series module according to the characteristic of this electret microphone. These inputs are the standard ones used for an external headset or a handsfree kit.

AC coupling is already embedded in the module.

2.11.3.2.1 Differential connection

Impedance of the microphone input in differential mode:

- Module ON: R_{in} = 10KΩ +/-10%
- Module OFF: R_{in} >1MΩ +/-10%

Typical implementation:

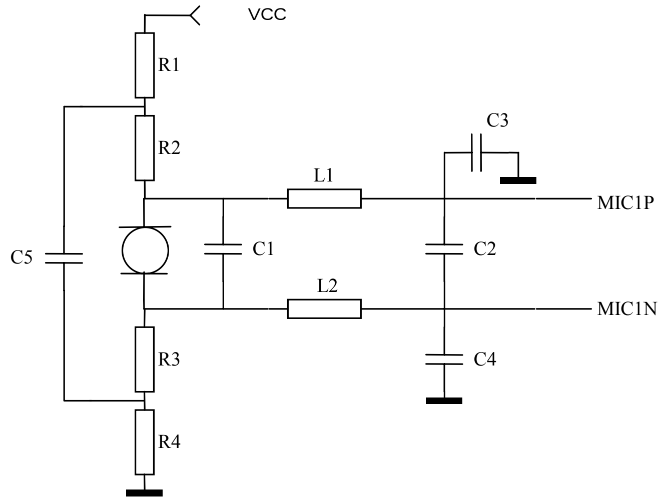


Figure 6 : MIC1 inputs (differential connection)

R1 = R4 = from 100 to 330Ω

R2 = R3 = usually between 1KΩ and 3.3KΩ as per the microphone characteristics

C1 = 10pF to 33pF

C2 = C3 = C4 = 47pF to 100pF

C5 = 47µF

L1 = L2 = 100nH

R1 and R4 are used as a voltage supply filter with C5.

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

C2 has to be very close to the WISMO Quik Q2403 Series connector.

L1, L2, C3 and C4 has to be put near the WISMO Quik Q2403 Series connector and can be removed according to their environment (ground plane, shielding ...etc). The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

2.11.3.2.2 Single-ended connection

Typical implementation:

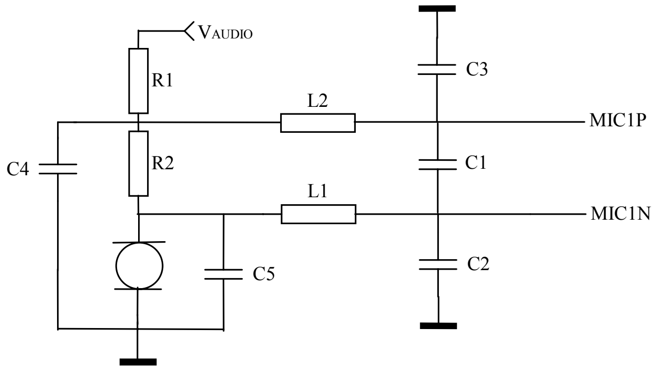


Figure 7 : MIC1 inputs (single-ended connection)

Note: VAUDIO must be very "clean" in single-ended connection (for example, VCC plus filter cell like RC or LC).

R1 = from 100 to 330Ω

R2 = usually between 1KΩ and 3.3KΩ as per the VAUDIO voltage level and the microphone characteristics

C1 = 10pF to 33pF

C2 = C3 = C5 = 47pF to 100pF

C4 = 47µF

L1 = L2 = 100nH

R1 is used as a voltage supply filter with C4.

C5 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

C1, C2, C3 have to be very close to the WISMO Quik Q2403 Series connector.

L1, and L2 has to be put near the WISMO Quik Q2403 Series connector and can be removed according to their environment (ground plane, shielding ...etc). The best way is to plan all the components and to remove those which are not necessary to filter out the TDMA noise on the audio path.

Pin description

Signal	Pin #	I/O	I/O type	Description
MIC1P	42	I	Analog	Microphone 1 positive input
MIC1N	44	I	Analog	Microphone 1 negative input

2.11.4 Speaker outputs

2.11.4.1 Speaker 2 Outputs

Pin description

Signal	Pin #	I/O	I/O type	Description
SPK2P	45	O	Analog	Speaker 2 positive output
SPK2N	47	O	Analog	Speaker 2 negative output

2.11.4.2 Speaker 1 Outputs

Pin description

Signal	Pin #	I/O	I/O type	Description
SPK1P	41	O	Analog	Speaker 1 positive output
SPK1N	43	O	Analog	Speaker 1 negative output

2.11.5 Buzzer Output

The buzzer output is a digital one. A buzzer can be directly connected between this output and VBATT. The maximum current is 80 mA (PEAK). A diode against transient peak voltage must be connected as described below.

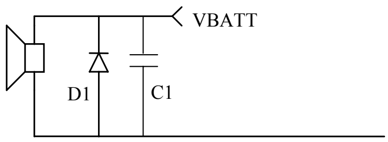


Figure 8 : Buzzer connection

C1: depends on the buzzer type.

Pin description

Signal	Pin #	I/O	I/O type	Description
BUZ	49	O	Analog	Buzzer output

Operating conditions

Parameter	Condition	Min	Max	Unit
V_{OL}	Imoy = 40mA		0.6	V
I_{PEAK}	VBATT = VBATTmax		80	mA
$I_{AVERAGE}$	VBATT = VBATTmax		40	mA

2.12 Battery charging interface

The WISMO Quik Q2403 Series module supports one battery charging circuit for Li-Ion batteries. This circuit uses an interface which consists of a current source inputs (CHG_IN) where the constant current has to flow in order to charge the battery. This current value depends on the battery capacity. It is recommended to provide a current equal to the value of the capacity plus 50mA. For a 550mA battery the current will be 600mA. The maximum current is 800mA.

A specific AT command (+WCBM), available from 4.3 level, allows to manage the charge battery (start and stop the charge, enable or disable unsolicited Battery Charge Indications and set the battery charge parameters).

The WISMO Quik Q2403 Series module monitors the battery voltage to detect the end of the charge. WISMO Quik Q2403 Series also monitors the temperature of the battery through the BAT_TEMP pin which has to be connected to a temperature sensor inside the battery (a NTC resistor for instance).

Pin description

Signal	Pin number	I/O	I/O type	Description
CHG_IN	1, 2, 4	I	Analog	Current source input
BAT_TEMP	38	I	Analog	A/D converter

Electrical Characteristics

Parameter	Min	Max	Typ	Unit
BAT_TEMP resolution	10			bits
BAT_TEMP sampling rate	90.3			Ksps/s
BAT_TEMP Input Impedance (R)	4.7			kΩ
BAT_TEMP Input Impedance (C)		100		nF
CHG_IN Voltage (for I=Imax)	+VBATT max + 0.7V	TBD*		V
CHG_IN Current		800		mA
BAT_TEMP Input signal range			2.8	V

* To be parametrized as per battery manufacturer

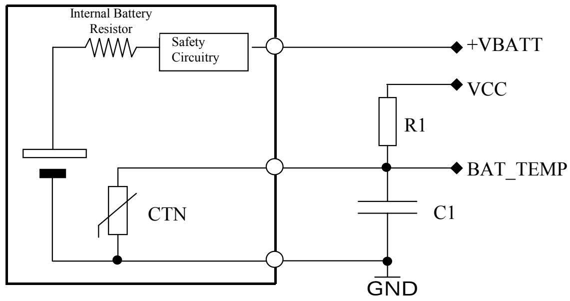


Figure 9 : Connection examples

2.12.1 Li-ion charging procedure

A constant current source has to be provided through CHG_IN input in order to charge the Li-ion battery, and BAT_TEMP input has to be connected to a battery temperature sensor. During this procedure the voltage of the battery is accurately monitored.

The Li-ion charging involves two phases. During the first phase, the battery is charged with a constant current until its voltage reaches 4.1V*. During the second phase the constant current is pulsed by the module. The width and the frequency of the pulse change during this phase in order to ensure a safety charge. The battery is considered as fully charged when, after a pulse, the voltage remains at a 4.1V* during more than 10s.

The Li-ion battery must have an included safety circuit to avoid any discharge or overcharge. This circuit is delivered by the manufacturer inside the battery pack. The impedance of this safety circuit has to be the lowest possible in order to reduce the drop-out of the voltage. This drop-out is due to the RF Power Amplifier current (up to 2.0A). A maximum of 150mΩ is required.

(*): To be parameterized as per battery manufacturer

2.12.2 How to define R1 and C1

<u>How to choose R1</u>

R1 has to be chosen to have a full range of BAT-TEMP (from 0V to 2.8V) when the CTN value changes from the minimum to the maximum temperature

<u>How to choose C1</u>

C1 has to be chosen to have a RC filter with a time constant lower than 2ms.

Calculation examples

CTN(25°C) = 47K

CTN(55°C) = 10K

CTN(-10°C) = 300K

CTN(-10°C) x VCC = (CTN(-10°C) + R1) x BAT-TEMP (full range)

R1= 47K ⇨ BAT-TEMP(-20°C) = 2.42V

BAT-TEMP(55°C) = 0.49V

R(-20°C) = R1//CTN(-10°C) = 40K

R(+55°C) = 8K

With C= 10nF::

RC(-20°C) = 400μs

RC(+55°C) = 80μs

2.13 ON / ~OFF

This input is used to switch ON or OFF the WISMO Quik Q2403 Series module. A high level signal has to be provided on the pin ON/~OFF to swith ON the module. The level of the voltage of this signal has to be maintained between 2.4V and VDD during a minimum of 500ms. This signal can be left at high level until switched off.

To be able to switch OFF the module, the pin ON/OFF has to be released. Through the firmware, the module can be switched off (using the CPOF command).

Pin description

Signal	Pin number	I/O	I/O type	Description
ON/~OFF	6	I	CMOS	Module Power ON

Electrical Characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	10		kΩ
Input Impedance (C)		50	pF

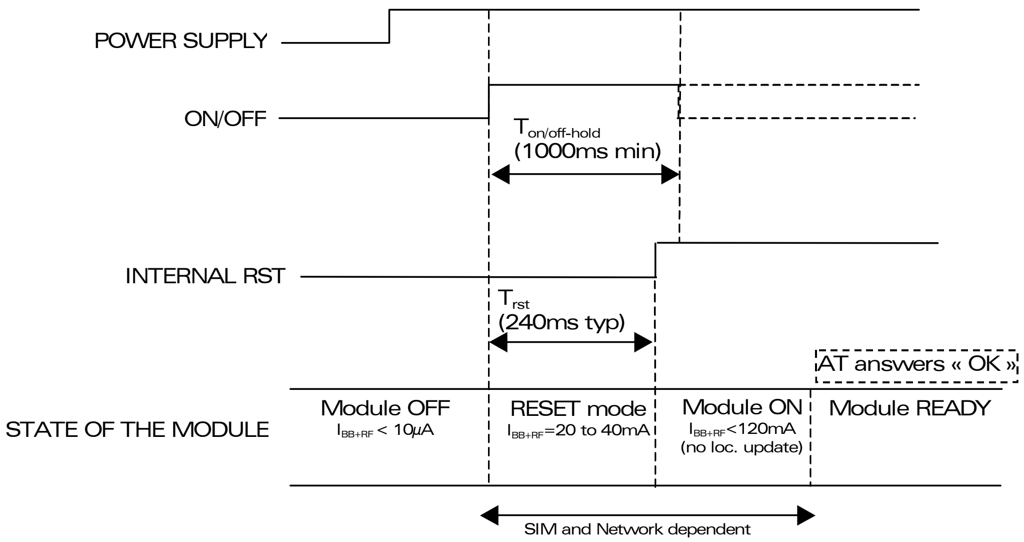
Operating conditions

Parameter	I/O type	Min	Max	Unit
V_{IL}		0 V	0.6 V	V
V_{IH}		2.4 V	VDD+0.5V	V

2.13.1 Operating sequences

2.13.1.1 Power ON

Once the module supplied, the application must set the ON/OFF signal to high to start the module power ON sequence. The ON/OFF signal must be hold for 500ms minimum. After this time, an internal mechanism keeps it on hold. During the power ON sequence, an internal reset is automatically performed by the module for 240ms (typical). During this phase, any external reset should be avoided. Once the initialisation is complete (timing is SIM and network dependent) the AT interface answers « OK » to the application[4]. For further details, please check the AT commands manual (+WIND, +WAIP)



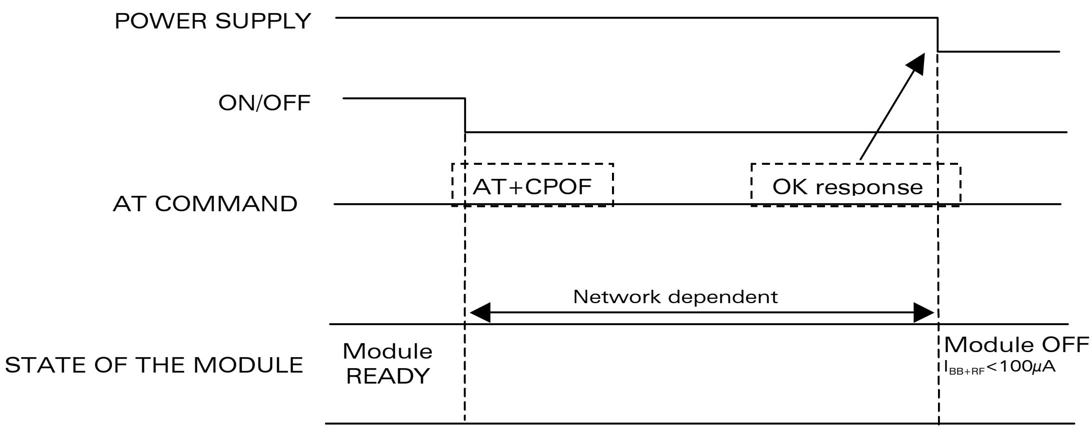
I_{BB+RF} = overall current consumption (Base Band + RF part)

Figure 10 : Power-ON sequence (no PIN code activated)

[4] For this, the application has to send AT↵. If the application manages hardware flow control, the AT command can be sent during the initialisation phase. Another solution is to use the +WIND command to get an unsolicited status from the module.

2.13.1.2 Power OFF

To properly power OFF the module, the application must set the ON/OFF signal to low and then send the AT+CPOF command to de-register from the network and switch off the module. Once the « OK » response is issued by the module, the power supply can be switched off.



I_{BB+RF} = overall current consumption (Base Band + RF part)

Figure 11 : Power-OFF sequence

2.14 BOOT (optional)

This input can be used to download a software in the Flash ROM of the WISMO Quik Q2403 Series module. For the applications based on AT commands this is a backup download procedure only (see chapter Firmware upgrade). The internal boot procedure is started when this pin is low during the reset of the module. In normal mode this pin has to be left open. In Internal boot mode, low level has to be set through a 1KΩ resistor. If used, this input has to be driven by an open collector or an open drain.

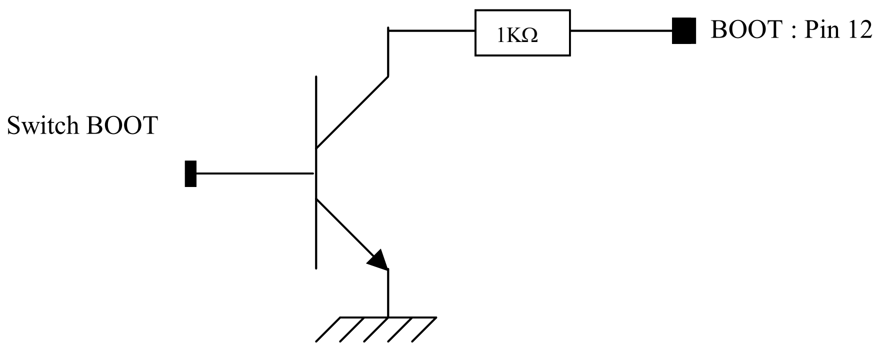


Figure 12 : BOOT pin connection

- If Switch Boot = 1, Boot pin 12 = 0, for download mode
- If Switch Boot = 0, Boot pin 12 = 1, for normal mode

Pin description

Signal	Pin number	I/O	I/O type	Description
BOOT	12	I	CMOS	Flash Loading

Note: The nominal firmware download procedure is using the X-modem

2.15 Reset signal (~RST)

This signal is used to force a reset procedure by providing low level during at least 100µs. This signal has to be considered as an emergency reset only. A reset procedure is already driven by an internal hardware during the power-up sequence.

This signal can also be used to provide a reset to an external device. It then behaves as an output. If no external reset is necessary this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain.

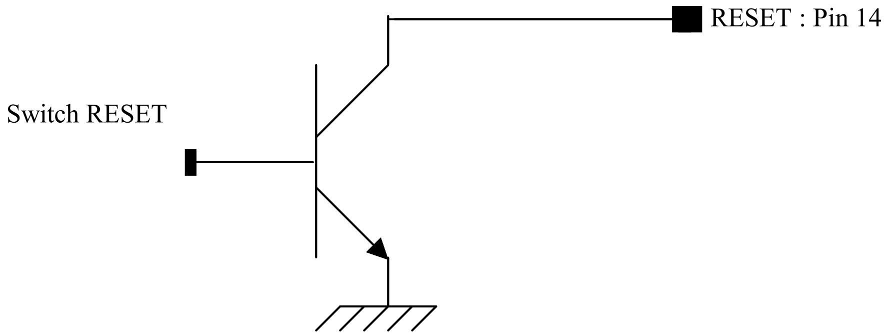


Figure 13 : RST pin connection

- If Switch Reset = 1, Reset pin 14 = 0
- If Switch Reset = 0, Reset pin 14 = 1

Pin description

Signal	Pin number	I/O	I/O type	Description
~RST	14	I/O		Module Reset

Electrical Characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	4.7		kΩ
Input Impedance (C)		10	nF

Operating conditions

Parameter	Min	Max	Condition
*V_{T-}	1.1V	1.2 V	
*V_{T+}	1.7V	1.9 V	
V_{OL}		0.4 V	I_{OL} = -50 μA
V_{OH}	2.0 V		I_{OH} = 50 μA

* V_{T-}, V_{T+} : Hysterisis Level

Additional comments on RESET:

The RESET process is activated either by the external ~RST signal OR by an internal signal (coming from a RESET generator). This automatic reset is activated at Power-up.

The module remains in reset mode as long as the RST signal is held low. This signal should be used only for "emergency" resets.

A software reset will be preferred to a HW reset.

2.15.1 Reset sequence

To activate the « emergency » reset sequence, the ~RST signal has to be set to low for 100µs minimum. As soon as the reset is complete, the AT interface answers « OK » to the application[5].

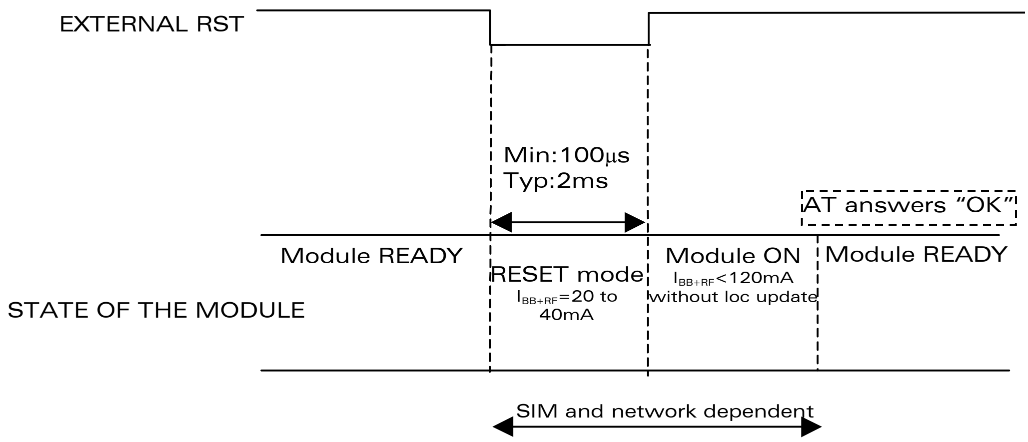


Figure 14 : Reset sequence

[5] For this, the application has to send AT↵. If the application manages hardware flow control, the AT command can be sent during the initialisation phase. Another solution is to use the +WIND command to get an unsollicited status from the module.

2.16 External Interrupt (~INTR)

The WISMO Quik Q2403 Series provides an external interrupt input (not managed in the standard AT commands firmware). This input is very sensitive and an interrupt is activated on high to low edge. If this signal is not used it can be left open. If used this input has to be driven by an open collector or an open drain.

This input is used for instance to power OFF automatically the module.

Pin description

Signal	Pin number	I/O	I/O type	Description
~INTR	16	I	CMOS	External Interrupt

Electrical characteristics

Parameter	Min	Max	Unit
V_{IL}	-0.5V	0.7V	Volt
V_{IH}	2.2V	3.0V	Volt

2.17 VCC output

This output can be used to power some external functions. VCC has to be used as a digital power supply. This power supply is available when the module is on.

Pin description

Signal	Pin number	I/O	I/O type	Description
VCC	40	O	Supply	Digital supply

Operating conditions

Parameter	Condition	Min	Max	Unit
Ouput voltage	I = 10mA	2.74	2.86	V
Output Current			10	mA

2.18 VCC_RTC (Real Time Clock)

2.18.1 Interface description

This pin is used as a back-up power supply for the internal Real Time Clock. The RTC is supported by the module when powered on but a back-up power supply is needed to save date and hour when the module is switched off.

If the RTC is not used this pin can be left open.

Pin description

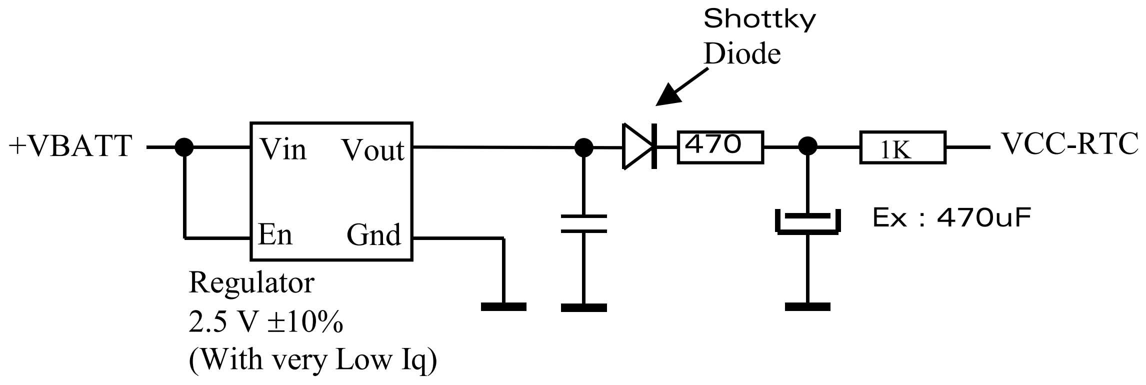
Signal	Pin number	I/O	I/O type	Description
VCC_RTC	56	I/O	Supply	RTC Back-up supply

Operating conditions

Parameter	Condition	Min	Max	Unit
Input voltage		2	2.75	V
Input Current	VCC=0V; t° = 25°C VCC_RTC=2.5V		3	µA
Input Current	VCC=0V; t°:-20°C / 55°C VCC_RTC=2.5V		10	µA
Output voltage		2.4	2.75	V
Output current			2	mA

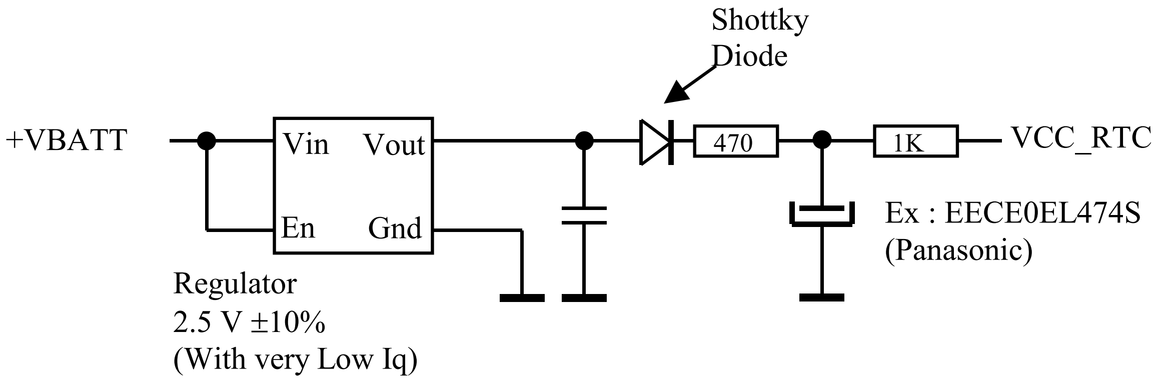
2.18.2 Typical implementation

2.18.2.1 Capacitor



Estimated range with 470 µF Capacitor: ~30 seconds.

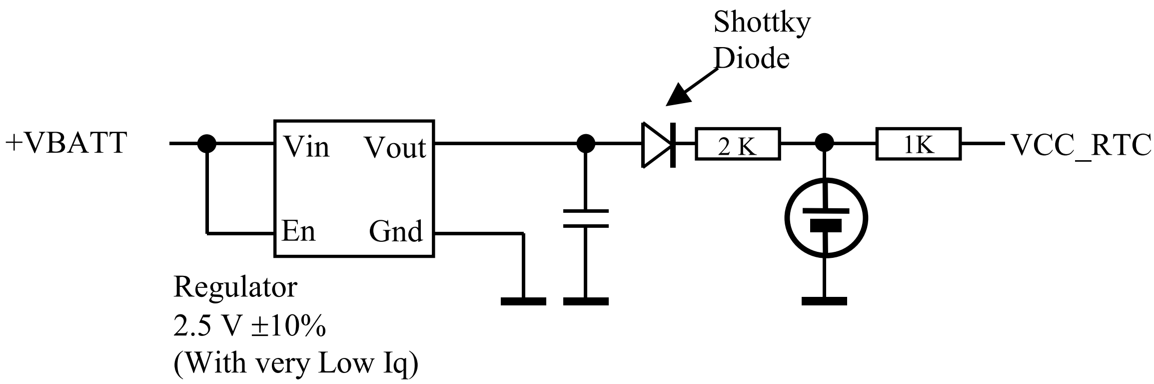
2.18.2.2 Super Capacitor



Estimated range with 0.47 Farad Gold Cap: 2 hours min.

Note: the Gold Capacitor maximum voltage is 2.5 V.

2.18.2.3 Battery cell with regulator

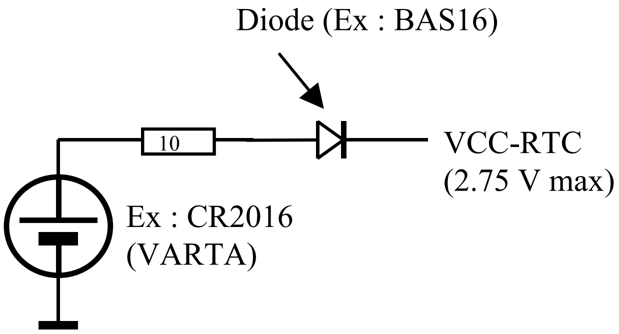


Estimated range with 2 mAh battery rechargeable battery: ~3 days.

Warning: Before battery cell assembly insure that cell voltage is lower than 2,75V to avoid any damage to the WISMO module.

2.18.2.4 Non Rechargeable battery

This is the less recommended solution.



Estimated range with 85 mAh battery: 4000 h minimum

Note: The “non rechargeable battery” is always active, except when the module is ON.

2.19 RF interface

The impedance is 50 0Ohms nominal and the DC impedance is 0 Ohm.

2.19.1 RF connection

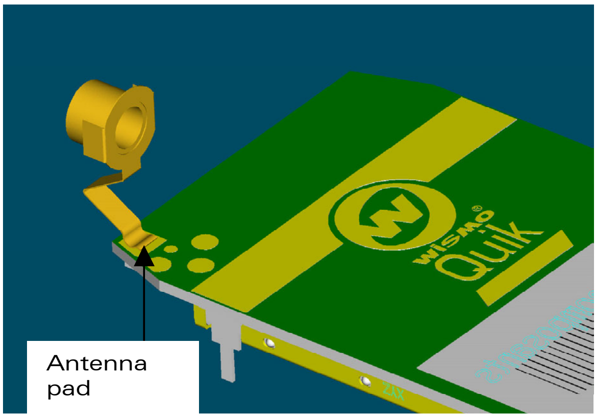
Two land patterns set on the PCB support the RF connection which can be used by the application through spring contacts or a soldered RF cable.

There are two possible ways to connect an antenna to the module:

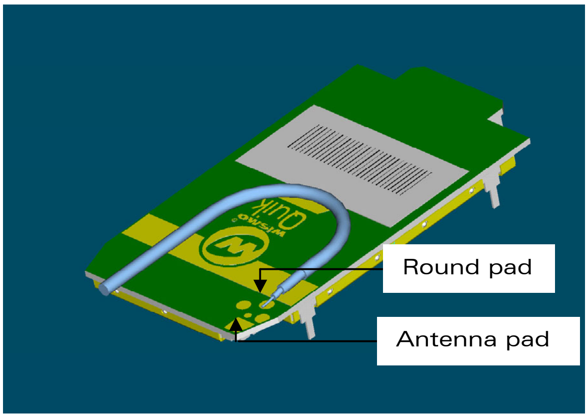
- The antenna can be directly connected to the module on the "Antenna pad" by using a spring contact.
- The antenna can be connected to the module through a coaxial cable. The coaxial cable is connected to both the "Round pad" and the "Ground pad".

Since no standard spring contact is available for WISMO Quik Q2403 Series, this solution requires a specific part to be developed.

The soldered solution will preferably be based on a RG178 coaxial cable with the following stripping and mounting guidelines:



Antenna connection by spring contact.



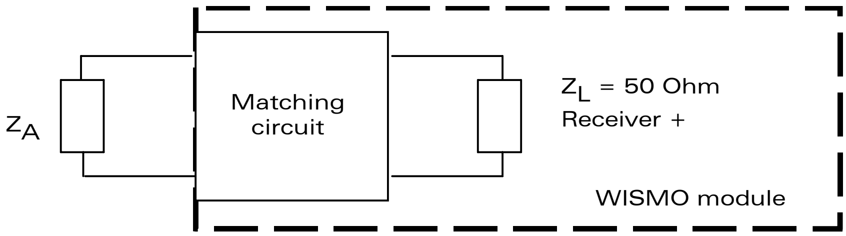
Antenna connection by coaxial cable.

Note:

- The WISMO™ Quik Q2403 Series does not include an antenna switch for a car kit but this function can be implemented externally and it can be driven using a GPIO.
- The antenna cable and connector should be chosen in order to minimize losses in the frequency bands used for GSM 900MHz and GSM1800MHz.
- 0.5dB can be considered as a maximum value for loss between the module and an external connector.

2.19.1.1 Antenna directly connected to the module: matching circuit

The goal of the matching circuit is to link the antenna (impedance ZA) to the receiver and transmitter access of the module (impedance ZL = 50 Ohm real).



The matching circuit is composed by four elements implemented (see Figure 15 and Figure 16) on the module connecting the "Antenna pad" to the "Round pad" (access to the receiver and the transmitter).

The four elements of the matching circuit are not yet defined, and depend on each antenna and mechanical integration. The matching circuit must be verified in both frequency bandwidths: 900 MHz (880 to 960 MHz) and 1800 MHz (1710 to 1880 MHz).

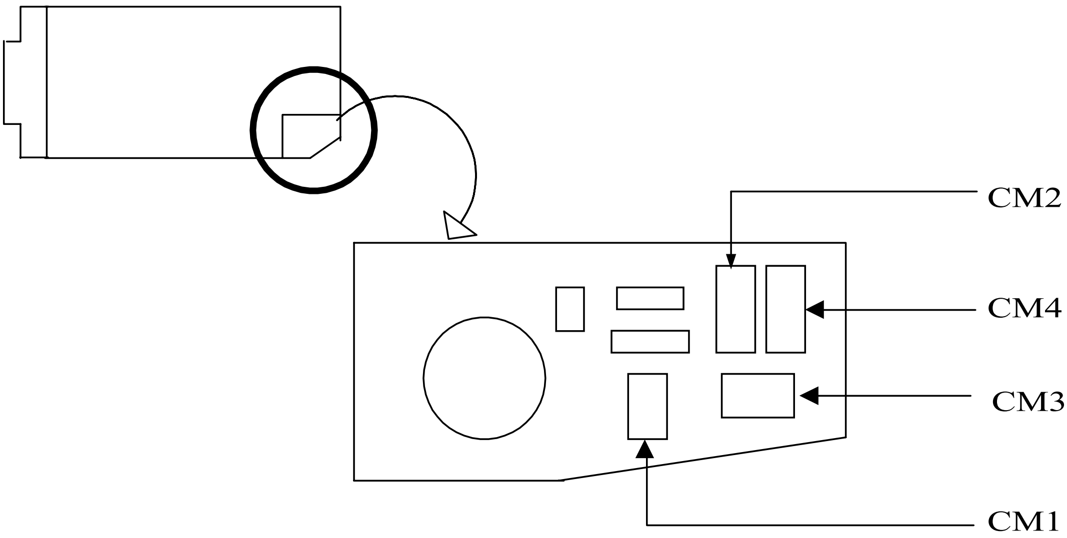


Figure 15: WM2D-G900/G1800 antenna matching circuit (bottom view)

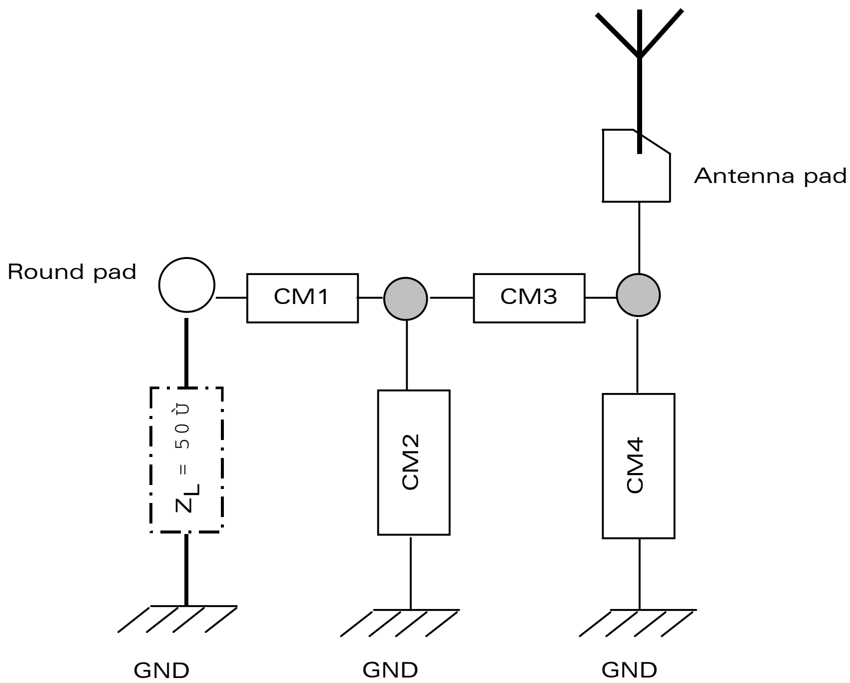


Figure 16: Electrical diagram for the WM2D-G900/G1800

2.19.2 RF performances

RF performances are compliant with the ETSI recommendation 05.

The main parameters for the receiver are:

- EGSM/900 Sensitivity: < -102 dBm Static & TUHigh
- GSM1800 Sensitivity: < -102 dBm Static & TUHigh
- Selectivity @ 200 kHz: > +9 dBc
- Selectivity @ 400 kHz: > +41 dBc
- Dynamic range: 63 dB
- Co-channel rejection: >= 9 dBc

The main parameters for the transmitter are:

- Maximum output power (EGSM): 33 dBm +/- 2 dB at ambient temperature
- Maximum output power (GSM1800): 30 dBm +/- 2 dB at ambient temperature
- Minimum output power (EGSM): 5 dBm +/- 5 dB at ambient temperature
- Minimum output power (GSM1800): 0 dBm +/- 5 dB at ambient temperature
- H2 level: < -30 dBm
- H3 level: < -30 dBm
- Noise in 925 - 935 MHz: < -67 dBm
- Noise in 935 - 960 MHz: < -79 dBm
- Noise in 1930 - 1990 MHz (GSM1900 band): < -71 dBm
- Phase error at peak power: < 5 ° RMS
- Frequency error: +/- 0.1 ppm max

2.19.3 Antenna specifications

The antenna must fulfil the following requirements:

- Frequency bands: dual band E-GSM 900MHz – GSM 1900 MHz

	EGSM 900	GSM 1900
Frequency RX	925 to 960 MHz	1930 to 1990 MHz
Frequency TX	880 to 915 MHz	1850 to 1910 MHz

- Impedance: 50Ω
- VSWR Tx max 2:1 / Rx max 2:1
- Typical radiated gain: 0dBi

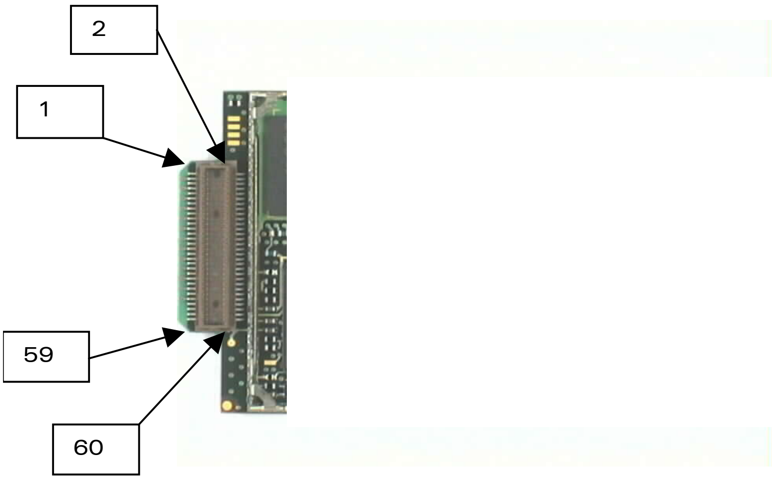
3 Technical specifications

3.1 Interfaces

Pin #	Name	I/O	I/O type	Description	Comment
1	CHG_IN	I	Supply	Supply for battery charging	High current
2	CHG_IN	I	Supply	Supply for battery charging	High current
3	SIMCLK	O	2 X	Clock for SIM interface	
4	CHG_IN	I	Supply	Supply for battery charging	High current
5	SIMRST	O	2 X	Reset for SIM interface	
6	ON/~OFF	I	CMOS	Power ON/OFF control	
7	SIMDATA	I/O	CMOS / 3X	I/O for SIM interface	
8	SDA/SPI_IO	I/O	CMOS/1X	Wire interface or SPI Data	
9	SIMVCC	O	Supply	SIM card supply	6mA max
10	SCL/SPI_CLK	O	1X	Wire interface or SPI clock	
11	VDD	I	Supply	Low power supply	3.1V minimum or connected to VBATT
12	BOOT	I	CMOS	BOOT	Pull down through 1K for Flash downloading
13	ROW0	I/O	CMOS/1X	Keyboard Row	
14	~RST	I/O	SCHMITT	Module Reset	Active low
15	ROW1	I/O	CMOS/1X	Keyboard Row	
16	~INTR	I	CMOS	External interrupt	Active low. 100K Pull-up inside
17	ROW2	I/O	CMOS/1X	Keyboard Row	
18	GPI	I	CMOS	General Purpose Input	100K Pull-down inside
19	ROW3	I/O	CMOS/1X	Keyboard Row	
20	GPO2	O	1X	General Purpose Output	
21	ROW4	I/O	CMOS/1X	Keyboard Row	
22	GPO1	I/O	3X	General Purpose Output	
23	COL0	I/O	CMOS/1X	Keyboard Column	
24	GPIO0	I/O	CMOS/2X	General Purpose I/O	
25	COL1	I/O	CMOS/1X	Keyboard Column	

26	GPO0 or SPI_AUX	O	3X	General Purpose Output or SPI Aux enable SIM 3V / 5V	
27	COL2	I/O	CMOS/1X	Keyboard Column	
28	SPI_EN	O	1X	SPI enable	
29	COL3	I/O	CMOS/1X	Keyboard Column	
30	CT105/RTS	I	CMOS	RS232 interface Request To Send	Pull up to VCC with 100KΩ when not used
31	COL4	I/O	CMOS/1X	Keyboard Column	
32	CT104/RX	O	1X	RS232 interface – Receive	
33	AUXV0	I	Analog	Auxiliar ADC input 0	Can be tied to GND if not used
34	CT108-2/DTR	I	CMOS	RS232 interface Data Terminal Ready	Pull up to VCC with 100KΩ when not used
35	GPIO5	I/O	CMOS / 2X	General Purpose I/O	
36	CT107/DSR	O	1X	RS232 interface Data Set Ready	
37	CT106/CTS	O	1X	RS232 interface Clear To Send	
38	BAT_TEMP	I	Analog	ADC input for battery temperature measurement	Can be tied to GND if not used
39	CT103/TX	I	CMOS	RS232 interface – Transmit	Pull up to VCC with 100 KΩ when not used
40	VCC	O	Supply	2.8V digital supply output	10mA max.
41	SPK1P	O	Analog	Speaker 1 positive output	
42	MIC1P	I	Analog	Microphone 1 positive input	
43	SPK1N	O	Analog	Speaker 1 negative output	
44	MIC1N	I	Analog	Microphone 1negative input	
45	SPK2P	O	Analog	Speaker 2 positive output	
46	MIC2P	I	Analog	Microphone 2 positive input	
47	SPK2N	O	Analog	Speaker 2 negative output	
48	MIC2N	I	Analog	Microphone 2 negative input	
49	BUZ	O	Analog	Buzzer output	80mA max
50	SIMPRES	I	CMOS	SIM Card Detect	Tied to VCC when not used

51	GPIO3 or CT109 / DCD	I/O O	CMOS/2X	General Purpose I/O RS232 – Data Carrier Detect	
52	GPIO1 FLASH LED	I/O	CMOS/2X	General Purpose I/O Module State	
53	GPIO4	I/O	CMOS/2X	General Purpose I/O	
54	GPIO2 or CT125 / RI	I/O O	CMOS/2X	General Purpose I/O RS232 - Ring Indicator	
55	+VBATT		Supply	Battery Input	High current
56	VCC_RTC	I/O	Supply	RTC back-up supply	
57	+VBATT		Supply	Battery Input	High current
58	+VBATT		Supply	Battery Input	High current
59	+VBATT		Supply	Battery Input	High current
60	+VBATT		Supply	Battery Input	High current



WISMO Quik Q2403 series pin position (bottom view)

3.2 Climatic and mechanical environments

Conditions	Temperature range
Operating / Full GSM specifications compliant	-20°C to +55°C
Operating / functional	-20°C to +70°C
Storage	-30°C to +85°C

WISMO2D		ENVIRONNEMENTAL CLASSES		
TYPE OF TEST	STANDARDS	STORAGE Class 1.2	TRANSPORTATION Class 2.3	OPERATING (PORT USE) Class 7.3
Cold	IEC 68-2.1 Ab test	-25° C 72 h	-40° C 72 h	-20° C (GSM900) 16 h -10° C (GSM1800/1900) 16h
Dry heat	IEC 68-2.2 Bb test	+70° C 72 h	+70° C 72 h	+55° C 16 h
Change of temperature	IEC 68-2.14 Na/Nb test		-40° / +30° C 5 cycles t1 = 3 h	-20° / +30° C (GSM900) 3 cycles -10° / +30° C (GSM1800/1900): 3 cycles t1 = 3 h
Damp heat cyclic	IEC 68-2.30 Db test	+30° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1
Damp heat	IEC 68-2.56 Cb test	+30° C 4 days	+40° C 4 days	+40° C 4 days
Sinusoidal vibration	IEC 68-2.6 Fc test	5 - 62 Hz : 5 mm / s 62 - 200Hz : 2 m / s2 3 x 5 sweep cycles		
Random vibration wide band	IEC 68-3.36 Fdb test		5 - 20 Hz : 0.96 m2 / s3 20 - 500Hz : - 3 dB / oct 3 x 10 min	10 -12 Hz : 0.96 m2 / s3 12 - 150Hz : - 3 dB / oct 3 x 30 min

3.3 Mechanical specifications

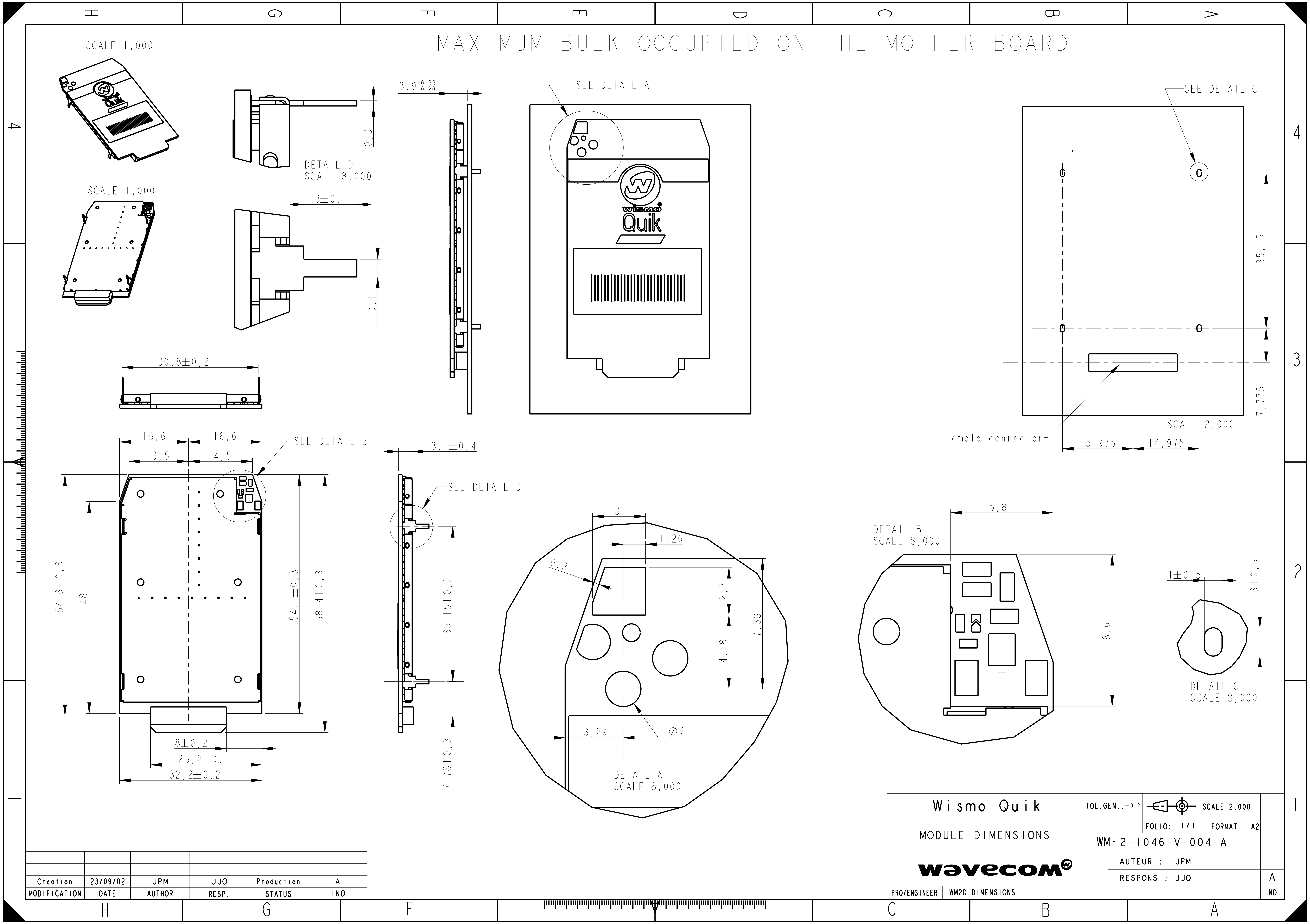
3.3.1 Physical characteristics

The WISMO Quik Q2403 Series module has a complete self-contained shield.

- Dimensions : 58.3 x 32.2 x 3.9 mm external dimensions (except shielding pins)
- Weight : <12 g

3.3.2 Mechanical drawings

The next page gives the mechanical specifications of WISMO Quik Q2403 Series.



MAXIMUM BULK OCCUPIED ON THE MOTHER BOARD
SCALE 1,000
SCALE 1,000
DETAIL D
SCALE 8,000
3±0,1
0,3
1±0,1
3,9 +0,35 -0,20
SEE DETAIL A
SEE DETAIL C
35,15
7,775
SCALE 2,000
female connector
15,975
14,975
30,8±0,2
15,6
16,6
13,5
14,5
SEE DETAIL B
3,1±0,4
SEE DETAIL D
54,6±0,3
48
54,1±0,3
58,4±0,3
35,15±0,2
7,78±0,3
8±0,2
25,2±0,1
32,2±0,2
3
1,26
0,3
2,7
4,18
7,38
3,29
Ø2
DETAIL A
SCALE 8,000
5,8
DETAIL B
SCALE 8,000
8,6
1±0,5
1,6±0,5
DETAIL C
SCALE 8,000
Wismo Quik
TOL.GEN.:±0,2
SCALE 2,000
FOLIO: 1/1
FORMAT : A2
MODULE DIMENSIONS
WM-2-1046-V-004-A
wavecom
AUTEUR : JPM
RESPONS : JJO
A
PRO/ENGINEER
WM2D_DIMENSIONS
IND.
Creation
23/09/02
JPM
JJO
Production
A
MODIFICATION
DATE
AUTHOR
RESP.
STATUS
IND

4 Connectors and peripheral devices references

4.1 General Purpose Connector

The GPC is a 60 pins connector with 0.5mm pitch from KYOCERA / AVX group with the following reference:

14 5087 060 930 861.

The matting connector has the following reference:

24 5087 060 X00 861[6].

The stacking height is 3.0 mm.

For further details see GPC data sheets in appendix. More information is also available from http://www.avxcorp.com

4.2 RF footprint

The RF footprint allows to connect on the mother board a ultra miniature coaxial connector IMP series from RADIALL with the following reference:

R 107 064.

The characteristics of this RF connector are in the appendix.

4.3 SIM Card Reader

- ITT CANNON CCM03 series (see http://www.ittcannon.com)
- AMPHENOL C707 series (see http://www.amphenol.com)
- JAE (see http://www.jae.com)

Drawer type:

- MOLEX 99228-0002 (connector) / MOLEX 91236-0002 (holder) (see http://www.molex.com)

[6] X=2 or 9

4.4 Microphone

Possible suppliers:

- HOSIDEN
- PANASONIC

4.5 Speaker

Possible suppliers:

- SANYO
- HOSIDEN
- PRIMO
- PHILIPS

4.6 Antenna Cable

The following cable reference has been qualified for being mounted on WISMO Quik Q2403 Series:

- RG178

4.7 GSM antenna

GSM antennas and support for antenna adaptation can be obtained from manufacturers such as:

- ALLGON (http://www.allgon.com)
- MOTECO (http://www.moteco.com)
- AMPHENOL (http://www.amphenol.com)
- GALTRONICS (http://www.galtronics.com)
- RADIALL / LARSEN (http://www.larsenantennas.com/)
- RANGESTAR (http://www.rangestar.com/)

4.8 RF connector

RF connector and accessories can be obtained from RADIALL:

- RADIALL (http://www.radiall.com/)

5 Design Guidelines

The following paragraphs aims give design guidelines.

5.1 HARDWARE and RF

5.1.1 EMC recommendations

The EMC tests have to be performed as soon as possible on the application to detect any possible problem.

When designing, special attention should be paid to:

- Possible spurious emission radiated by the application to the RF receiver in the receiver band
- ESD protection on SIM (if accessible from outside), serial link,...
- EMC protection on audio input/output (filters against 900MHz emissions)
- Bias of the Microphone inputs
- Length of the SIM interface lines (preferably <10cm)
- Ground plane: WAVECOM recommends to have a common ground plane for analog / digital / RF grounds.
- Metallic case or plastic casing with conductive paint are recommended

Note:

The module does not include any protection against overvoltage.

5.1.2 Power Supply

The power supply is one of the key issues in the design of a GSM terminal.

A weak power supply design could affect in particular:

- EMC performances
- the emissions spectrum
- the phase error and frequency error

Warning:

Careful attention should be paid to:

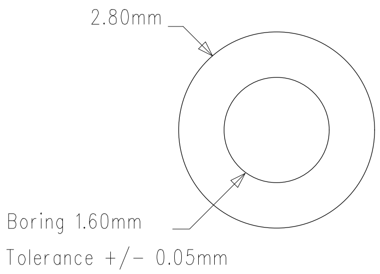
- Quality of the power supply: low ripple, PFM or PSM systems should be avoided (PWM converter preferred).
- Capacity to deliver high current peaks in a short time (pulsed radio emission).

5.1.3 Layout requirement

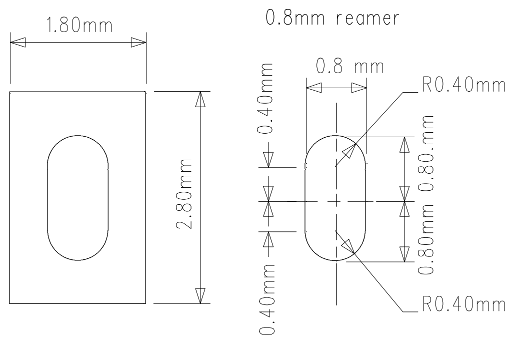
CHIPS & BORING DIAMETER

of the WISMO QUIK mechanical insertion pins

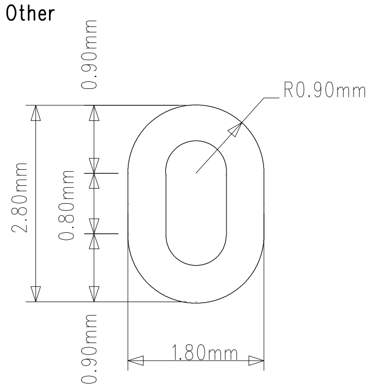
CASE N 1
To be used in priority



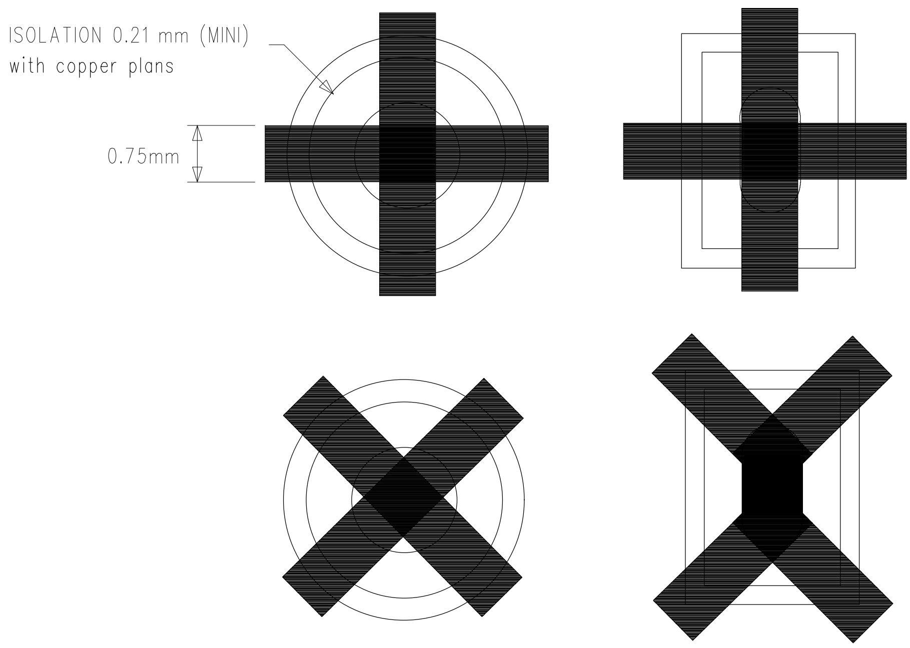
CASE N 2
on specific request



CASE N 3
Other



THERMAL BRAKES DEFINITION



NORMALISATION INDUSTRIELLE	ETABLI : HER	DATE : 03/04/02
WAVECOM	APPROUVE : DPL	SECTION : 1545
	CHIPS & BORING DIAMETER OF THE WISMO QUIK MECHANICAL INSERTION PINS	

5.1.4 Antenna

Antenna sub-system and integration in the application is a major issue.

Attention should be paid to:

- Choice of the antenna cable (type, length, performances, thermal resistance, etc)
- Antenna connector (type + losses)

These elements could affect GSM performances such as sensitivity and emitted power

The antenna should be isolated as much as possible from the digital circuitry (including the interface signals) ➔ it is strongly recommended to shield the terminal.

On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal.

Moreover, the power emitted through the antenna could affect the application.

> Warning:
>
> Wavecom strongly recommends to work with an antenna manufacturer either to develop an antenna adapted to the application or to adapt an existing solution to the application. The antenna adaptation (mechanical and electrical adaptation) is one of the key issues in the design of a GSM terminal.

5.2 Mechanical integration

Attention should be paid to:

- Antenna cable integration (bending, length, position, etc)
- Legs of the module to be soldered on the Ground plane

5.3 Firmware upgrade

The WISMO Quik Q2403 Series firmware is stored in flash memory and it can easily be upgraded.

In order to follow the regular evolutions of the GPRS standard and to offer state of the art software, Wavecom recommends that the application designed around a WISMO (or WISMO based product) allows easy firmware upgrades on the module via the standard Xmodem protocol. Therefore, the application shall either allow a direct access to the WISMO serial link through an external connector or implement any mechanism allowing the WISMO firmware to be downloaded via Xmodem.

Two upgrade procedures are available:

5.3.1 Nominal upgrade procedure

The firmware file can be downloaded into the modem using the Xmodem protocol.

To enter this mode, the AT+WDWL command (see description in the AT command manual) has to be sent.

The necessary serial signals to proceed with the Xmodem downloading are:

Rx, Tx, RTS, CTS and GND.

5.3.2 Backup procedure

In case the nominal upgrade mode is not possible (due to critical corruption on the flash memory), a backup procedure is also available. It requires a WAVECOM specific software to download the firmware file into the modem.

This tool has to run on a PC connected to the serial bus of the modem.

The necessary signals to proceed with the downloading are: Rx, Tx, RTS, CTS and GND.

Prior to running the WAVECOM downloader, the modem has to be set in download mode.

For this, the BOOT signal has to be set to low while powering ON (or reseting) the modem.

Note: To reduce the time of the download, it's possible to change the speed of the serial link at 115200 bits/s. for that, you have to execute the AT command below:

1) AT+IPR=115200
2) AT+WDWL
3) file transfer
4) AT+CFUN=1 (reset of the module)

Make attention that after the last command, the serial link will be by default at 9600 bits/s.

6 Appendix

6.1 Wavecom acceptance test

These tests are Wavecom internal qualification tests. They are performed on a Wavecom evaluation platform (module on test board).

Test	Applied standard	Acceptance criteria
Performance Test	ETSI recommendation for GSM900/GSM1800 (and GSM900/GSM1900) communication.	Full conformity to the recommendation regarding the main RF parameters.
Cooking Test	-	The test continues even after the Cooking Test milestone has been reached
Stress Test	Therma shocks IEC 68-2-14.	Full conformity to the recommendation regarding the main parameters.
Vibration Test	Sinusoidal vibration IEC 68-2-6.	No performance degradation or mechanical degradation is allowed after test.
Vibration Test	Random vibration IEC 68-2-36.	No performance degradation or mechanical degradation is allowed after test.
Shock Test	IEC 68-2-27.	No performance degradation or mechanical degradation is allowed after test.
Bump Test	IEC 68-2-29.	No performance degradation or mechanical degradation is allowed after test.
Humidity Test	Corrosion test IEC 68-2-3.	No visible degradation of the product, both visual and functionnal. The unit is tested at room temperature and must be fully operative for the main RF parameters.
Warehouse Tet	Low temperance IEC 68-2-1.	Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.
Warehouse Test	High temperature IEC 68-2-2.	Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.
Dust Test1	MIL-STD-810D, method 510-3.	No visible dust in the visible areas. No more than 50 dust particules in the cabinet of the product. The unit, tested at room temperature must be fully operative.
Light Test1	UV radiation and temperature EDF HN60E03.	Visual inspection on the discoloration and other degradation effects such as cracks in the material of the unit after the test.
Fall Test1	IEC 68-2-32.	Only minor casing degradation is allowed, with a maximum dimension change of 1mm. The unit must remain fully operative and full specification for the main RF parameters.

Electro Static Discharge Test	IEC 1000-4-2.	No performance degradation allowed after the test.
Salt Mist Test	IEC 68-2-11	After the test, visual inspection on the unit.
Atmosphere Test	Flowing mixed gas corrosion. IEC 68-2-60	After the test, visual inspection on the unit and inside.
Marking Test	EN 60 950	After the test, visual inspection on the unit. No degradation is allowed on the marking.

6.2 Reference documents

GSM ETSI recommendations for Phase I and Phase II.

Specification Reference	Title
GSM900/1800/1900 ph2 Radio	ETSI GSM 05.05 v7.1.0 release 1998
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 and GT 01 v4.2.1
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 and GT 01 v4.2.1
GSM ph2 Layer 2	ETSI GSM 04.06 and GT 01 v4.2.1
GSM900 ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
GSM1800 ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
GSM900/GSM1800 Multiband	ETSI GSM 02.07, 03.22, 04.08, 04.13, 05.05, 05.08 and GT 01 v4.2.1
GSM ph2 SIM	ETSI GSM 11.11 and GT 01 v4.2.1
GSM ph2 Teleservices	ETSI GSM 03.50 and GT 01 v4.2.1
GSM ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.11, 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and GT 01 v4.2.1
GSM1800 ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.11, 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and GT 01 v4.2.1
GSM1900 ph2+	EN 300 919 V7.1.0 (1999-07) European standard (Telecommunications series) Digital cellular telecommunications system (phase2+)

6.3 Safety recommendations (for information only)

IMPORTANT

FOR THE EFFICIENT AND SAFE OPERATION OF

YOUR GSM APPLICATION BASED ON WISMO Quik Q2403 Series

PLEASE READ THIS INFORMATION CAREFULLY

6.3.1 RF safety

6.3.1.1 General

Your GSM terminal[7] is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM terminal is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your GSM application, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

6.3.1.2 Exposure to RF energy

There has been some public concern about possible health effects of using GSM terminals. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was fitted for use.

If you are concerned about exposure to RF energy there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular terminal efficiently by following the below guidelines.

6.3.1.3 Efficient terminal operation

For your GSM terminal to operate at the lowest power level, consistent with satisfactory call quality:

If your terminal has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your GSM terminal operates more efficiently with the antenna fully extended.

Do not hold the antenna when the terminal is « IN USE ». Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

---

[7] based on WISMO2D

6.3.1.4 Antenna care and replacement

Do not use the GSM terminal with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the terminal and may contravene local RF emission regulations or invalidate type approval.

6.3.2 General safety

6.3.2.1 Driving

Check the laws and the regulations regarding the use of cellular devices in the area where you have to drive as you always have to comply with them. When using your GSM terminal while driving, please:

- give full attention to driving,
- pull off the road and park before making or answering a call if driving conditions so require.

6.3.2.2 Electronic devices

Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However RF energy may affect some improperly shielded electronic equipment.

6.3.2.3 Vehicle electronic equipment

Check your vehicle manufacturer representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

6.3.2.4 Medical electronic equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc...) to determine if they are adequately shielded from external RF energy.

Turn your terminal **OFF** in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

6.3.2.5 Aircraft

Turn your terminal OFF before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you to have permission from a crew member to use your terminal while the aircraft is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

6.3.2.6 Children

Do not allow children to play with your GSM terminal. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem, or make calls that increase your modem bills.

6.3.2.7 Blasting areas

To avoid interfering with blasting operations, turn your unit OFF when in a « blasting area » or in areas posted: « turn off two-way radio ». Construction crew often use remote control RF devices to set off explosives.

6.3.2.8 Potentially explosive atmospheres

Turn your terminal **OFF** when in any area with a potentially explosive atmosphere. It is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fueling areas such as petrol stations ; below decks on boats ; fuel or chemical transfer or storage facilities ; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

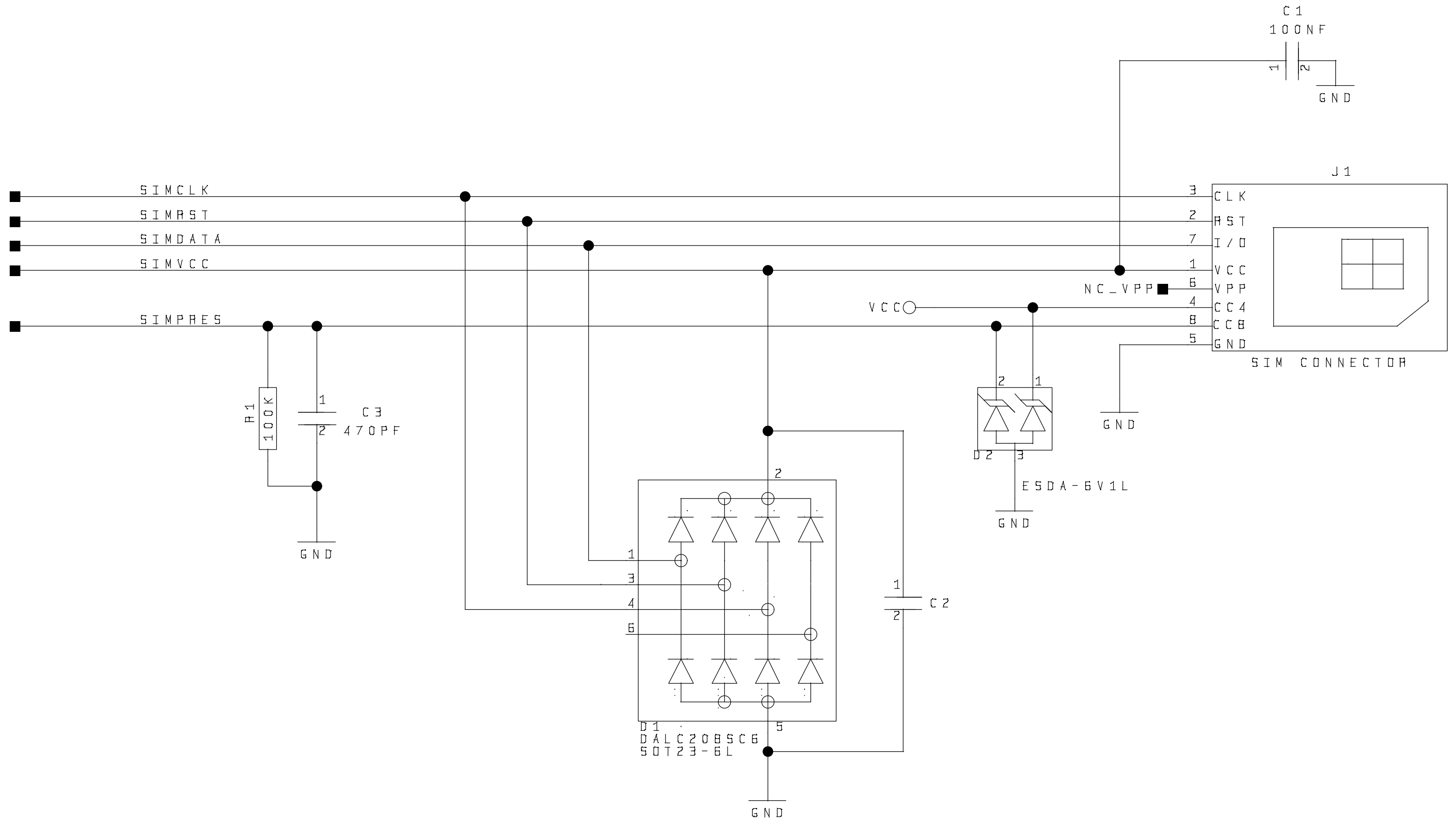
Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle which contains your terminal or accessories.

Before using your terminal in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

6.4 Application notes for the SIM interface

The next 2 pages are application notes to interface the module with SIM cards:

- application note #1: interface with 3V SIMs
- application note #2: interface with 3V/5V SIMs

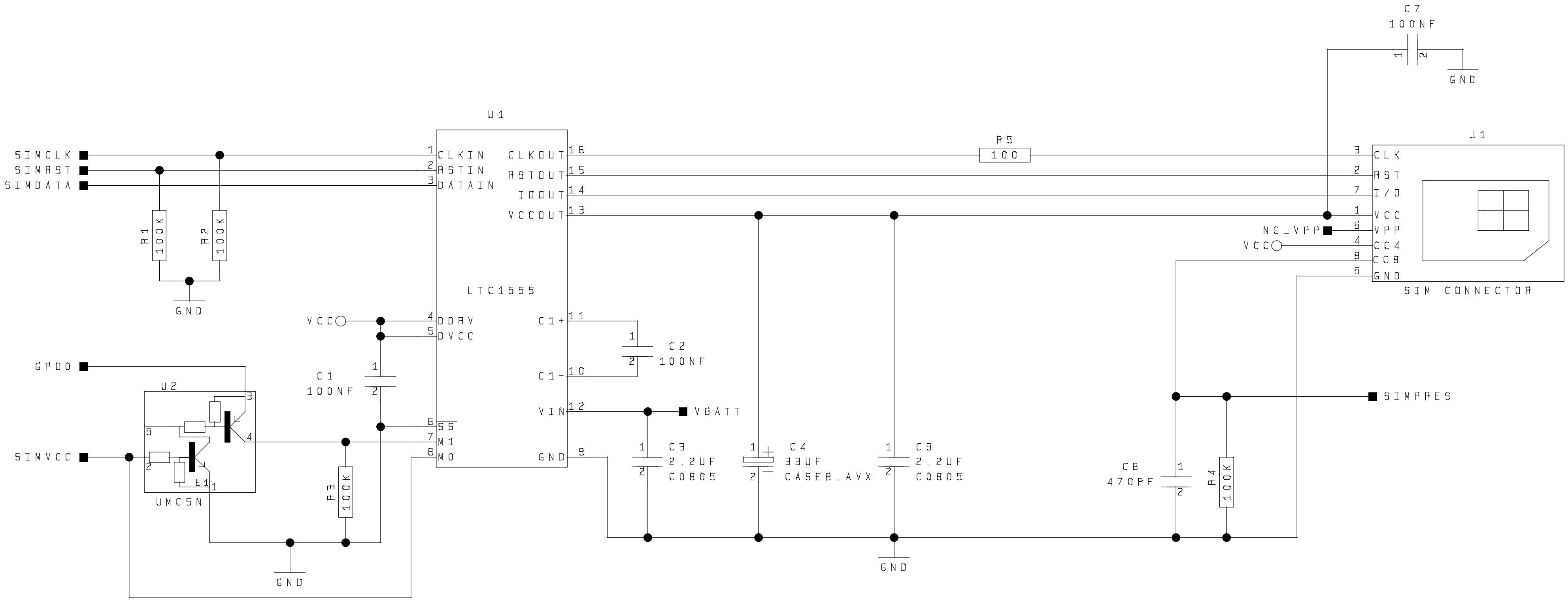


- C1 HAS TO BE CLOSE J1
- ESD PROTECTION CAPACITANCE IS LESS THAN 10PF FOR SIMDATA AND SIMCLK
- ESD PROTECTION HAS TO BE CLOSE J1
- 470nF Max for C2

WAVECOM

The shock wave in the wireless world

PROJECT: APPLICATION NOTE	Sheet: 1/1
SCHEMATIC:SIM 3V ONLY (WISMO2D)	
WAVECOM 39 Rue du Gouverneur Eboue 92130 ISSY LES MOULINEAUX FRANCE	Date: 10/10/2001 Version: 1.0 Eng:FDL



- C4 HAS TO BE CLOSE (13) & (9) OF U1
- C4 IS A LOW ESR TANTALUM CAPACITOR
- C7 HAS TO BE CLOSE J1

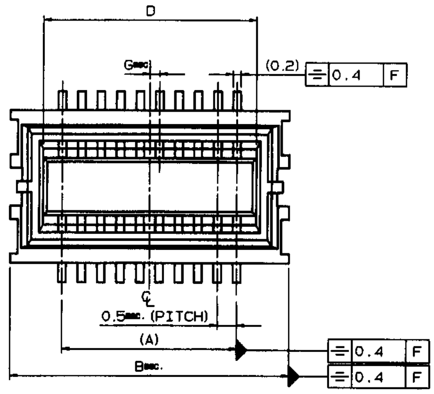
WAVECOM

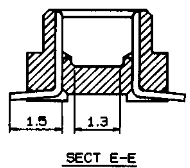
The shock wave in the wireless world

PROJECT:APPLICATION NOTE	Sheet: 1/1
SCHEMATIC:SIM 3V-5V (WISMO2D)	
WAVECOM 39 Rue du Gouverneur Eboue	Date: 10/10/2001
	Version: 1.0
92130 ISSY LES MOULINEAUX FRANCE	Eng:FDL

6.5 General Purpose Connector data sheet

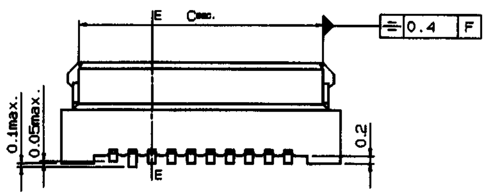
The next 6 pages are the KYOCERA/ELCO data sheets for the GPC (also available from http://www.avxcorp.com .

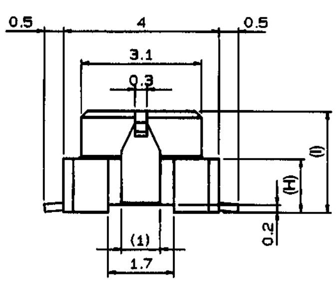


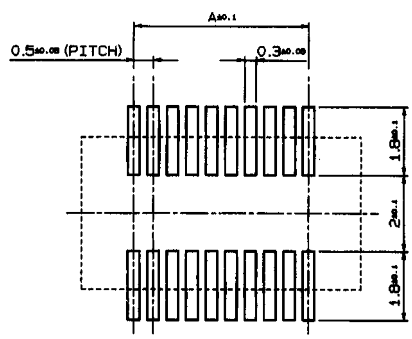


Surface Mount Vertical Plug

Specifications:
- 1000 per Tape and Reel
- Voltage - 50 V
- Current Rating - 0.4 A
- Dielectric Withstanding Voltage - 500 V
- Operating Temperature - (-25°C ~ +85°C)
- Contact Material - phosphor bronze
- Insulator Material - PPS (UL 94 V-0)







MOUNTING LAYOUT

No. of Pos.	P/N	A	B	C	D	G
20	10 5087 020 XX0 861	4.5/.177	7.2/.283	6.2/.244	5.5/.217	0.25/.0098
30	10 5087 030 XX0 861	7.0/.276	9.7/.382	8.7/.343	8.0/.315	0.50/.0196
36	10 5087 036 XX0 861	8.5/.335	11.2/.441	10.2/.402	9.5/.374	0.25/.0098
40	10 5087 040 XX0 861	9.5/.374	12.2/.480	11.2/.441	10.5/.414	0.25/.0098
50	10 5087 050 XX0 861	12.0/.472	14.7/.579	13.7/.539	13.0/.512	0.50/.0196
60	10 5087 060 XX0 861	14.5/.571	17.2/.677	16.2/.638	15.5/.610	0.25/.0098

Dimensions millimeters/inches

ORDERING CODE

Typical Example 14 5087 0XX 2XX 861

14: PLUG - Tape and Reel

NUMBER OF CONTACTS:

40, 60 : 3.0mm Stack
36, 40, 50 : 3.5mm Stack
20, 30, 36,
50, 60 : 4.0mm Stack

2: Without Adhesive Tape
9: Adhesive Cover Tape

VARIATION CODE:

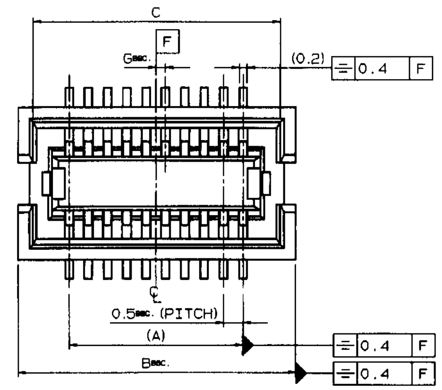
	H	I
30	.9	2.15
35	1.4	2.7
40	1.9	3.2

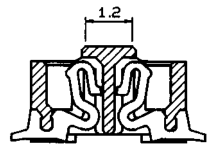
PLATING VARIATION:

861: 15 microinches of gold with gold flash tails

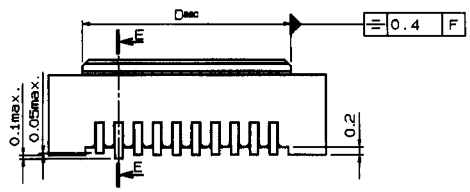
Consult factory for other sizes

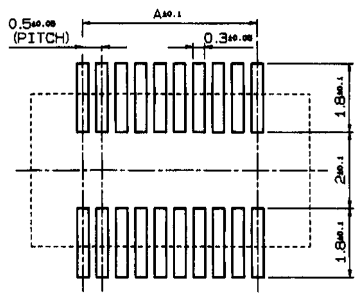
Surface Mount Vertical Receptacle

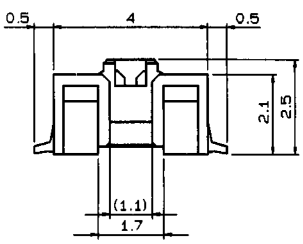



SECT E-E

Specifications:
- 1000 per Tape and Reel
- Voltage - 50 V
- Current Rating - 0.4 A
- Dielectric Withstanding Voltage - 500 V
- Operating Temperature - (-25°C ~ +85°C)
- Contact Material - phosphor bronze
- Insulator Material - PPS (UL 94 V-0)




MOUNTING LAYOUT



No. of Pos.	P/N	A	B	C	D	G
20	20 5087 020 x00 861	4.5/.177	7.2/.283	6.4/.252	5.4/.213	0.25/.0098
30	20 5087 030 x00 861	7.0/.276	9.7/.382	8.9/.350	7.9/.311	0.50/.0196
36	20 5087 036 x00 861	8.5/.335	11.2/.441	10.4/.409	9.4/.370	0.25/.0098
40	20 5087 040 x00 861	9.5/.374	12.2/.480	11.4/.449	10.4/.409	0.25/.0098
50	20 5087 050 x00 861	12.0/.472	14.7/.579	13.9/.547	12.9/.508	0.50/.0196
60	20 5087 060 x00 861	14.5/.570	17.2/.677	16.4/.646	15.4/.606	0.25/.0098

Dimensions millimeters/inches

ORDERING CODE

Typical Example **24** **5087** **0XX** **200** **861**

24: Receptacle - Tape and Reel

NUMBER OF CONTACTS:
20, 30, 36, 40, 50, 60

2: Without Adhesive Tape
9: Adhesive Cover Tape

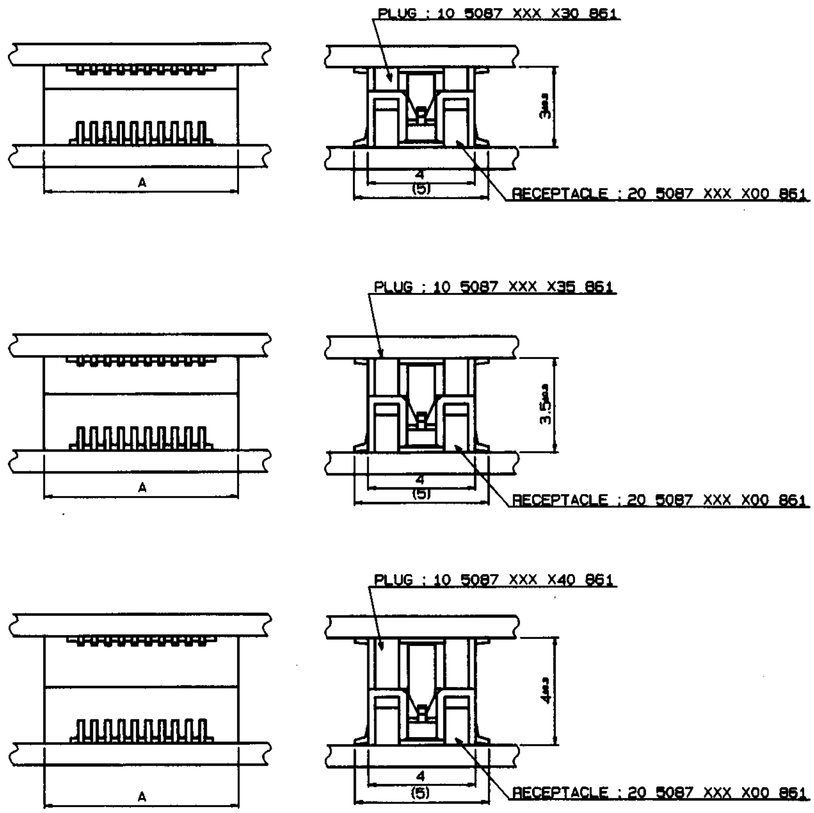
PLATING VARIATION:
861: 15 microinches of gold with gold flash tails

Consult factory for other sizes

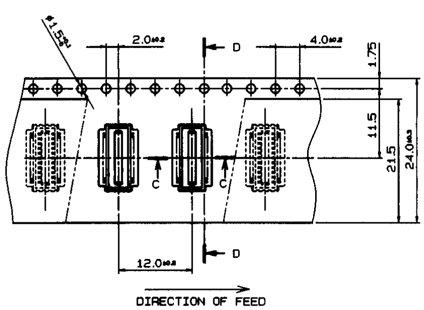
0,5 mm Spacing — Applications

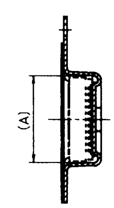
	P/N	Stacking Height
PLUG	10 5087 xxx x30 861	3.0
RECE.	20 5087 xxx x00 861	
PLUG	10 5087 xxx x35 861	3.5
RECE.	20 5087 xxx x00 861	
PLUG	10 5087 xxx x40 861	4.0
RECE.	20 5087 xxx x00 861	

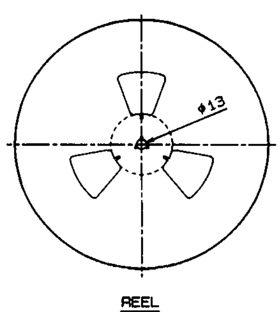
No. of Pos.	A
20	7.2/.283
30	9.7/.382
36	11.2/.441
40	12.2/.480
50	14.7/.579
60	17.2/.677

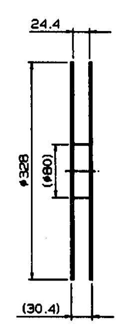


0,5 mm Spacing — Tape and Reel



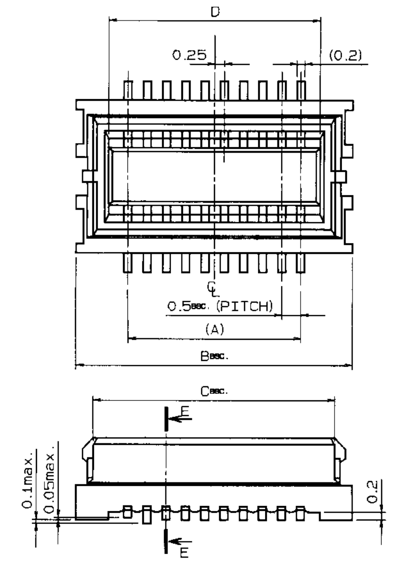


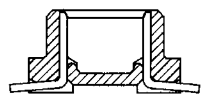


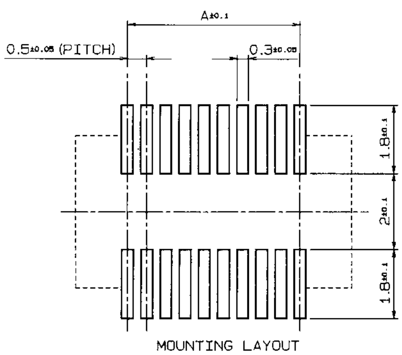


Super Micro Connectors 0.5mm Pitch

Series 5087 Plug







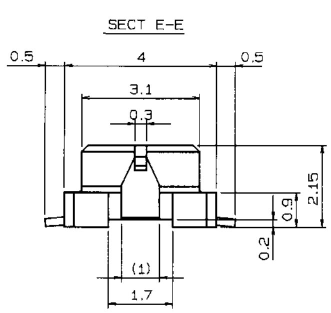
A = 0.5 (n/2 -1)
B = 0.5 (n/2 -1)+2.7
C = 0.5 (n/2 -1)+1.7
D = 0.5 (n/2 -1)+1.0

ORDERING CODE

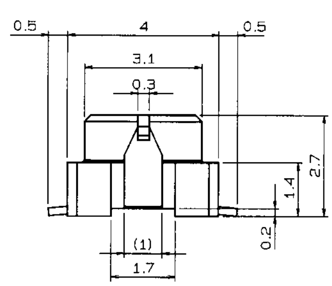
14 5087 0XX X XX 8XX

- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION
  - 30 : H = 3.0mm
  - 35 : H = 3.5mm
  - 40 : H = 4.0mm
- TYPE
  - 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (20, 30, 32, 36, 40, 50, 60)
- SERIES
- TAPE AND REEL 14 = Plug

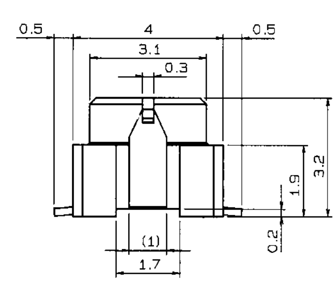
H = 3.0mm Type



H = 3.5mm Type

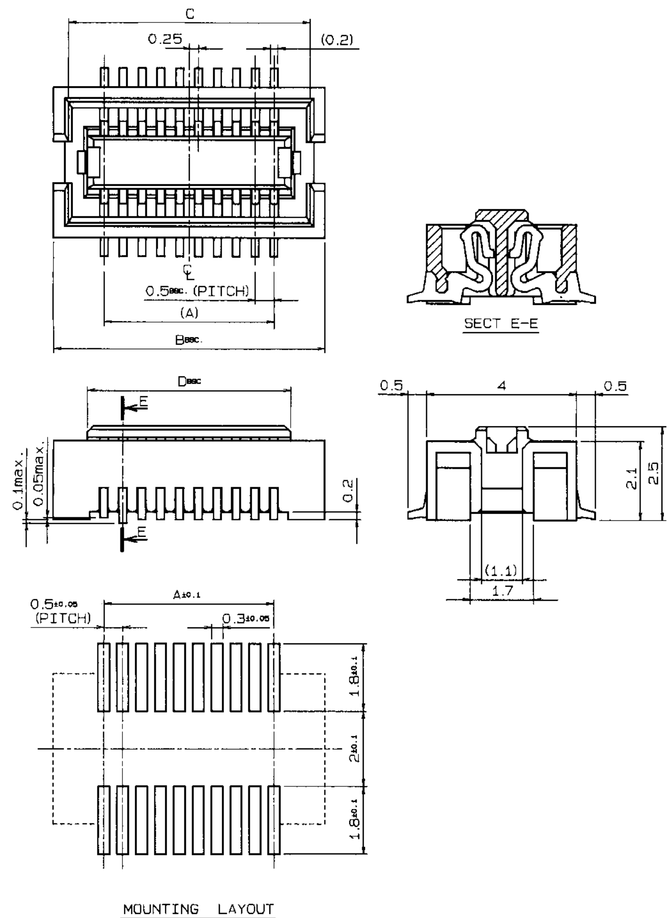


H = 4.0mm Type



Super Micro Connectors 0.5mm Pitch

Series 5087 Receptacle H = 3.0 ~ 4.0mm Type



ORDERING CODE

24 5087 0XX X 00 8XX

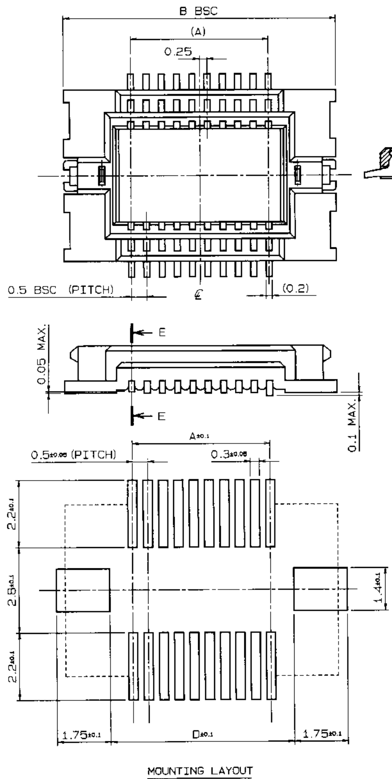
- FINISH
  - 861 = Ni Under Coated 1.25μm min. Gold-Mating Area Au 0.38μm min.
  - 829 = Ni Under Coated 1.25μm min. Gold-Mating Area Au 0.1μm min.
- VARIATION
  - H = 3.0 ~ 4.0mm
- TYPE
  - 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (20, 30, 32, 36, 40, 50, 60)
- SERIES
- TAPE AND REEL
  - 24 = Receptacle

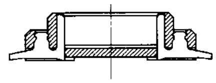
A = 0.5 (N/2 -1)
B = A +2.7
C = A +1.9
D = A +0.9

Additional information on this product is available from AVX's catalog or AVX's FAX Service.
Call 1-800-879-1613 and request document **#270**. Visit our website http://www.avxcorp.com

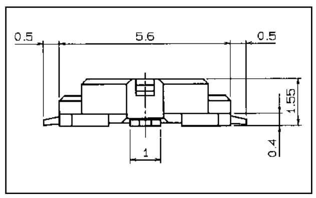
Super Micro Connectors 0.5mm Pitch

Series 5087 Plug

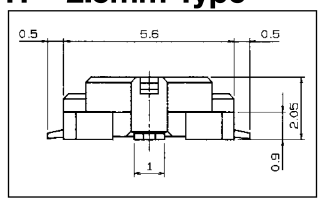




H = 2.0mm Type



H = 2.5mm Type



$A = 0.5 (\frac{n}{2} - 1)$

$B = 0.5 (\frac{n}{2} - 1) + 4.4$

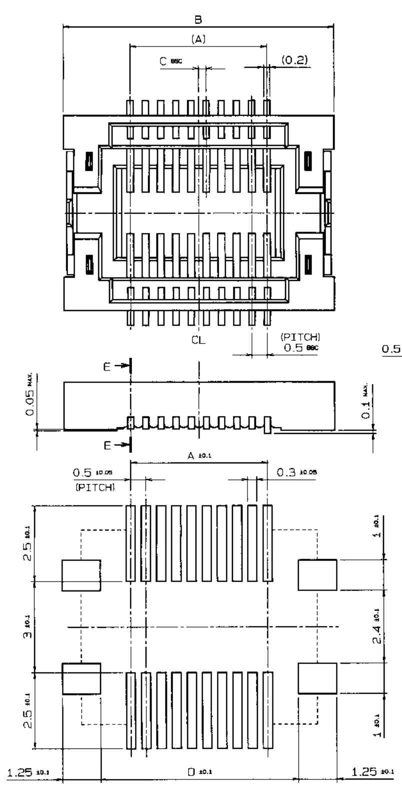
$D = 0.5 (\frac{n}{2} - 1) + 1.5$

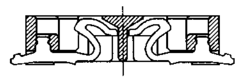
ORDERING CODE

14 5087 0XX X XX 8XX

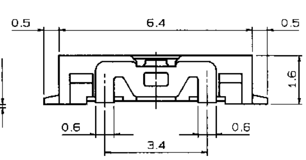
- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION
  - 20 : H = 2.0mm
  - 25 : H = 2.5mm
- TYPE
  - 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (10*, 20, 30, 40, 50, 60) *2.0mm H only
- SERIES
- TAPE AND REEL 14 = Plug

Series 5087 Receptacle H = 2.0 ~ 2.5mm Type





SECT E-E



ORDERING CODE

24 5087 0XX X 01 8XX

- FINISH
  - 861 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.38µm min.
  - 829 = Ni Under Coated 1.25µm min. Gold-Mating Area Au 0.1µm min.
- VARIATION H = 2.0 ~ 2.5mm
- TYPE
  - 0 = without Boss with Retention Clip
  - 2 = without Boss, Retention Clip
  - 9 = without Boss, Retention Clip, with Adhesive Tape
- NUMBER OF POSITIONS (10, 20, 30, 40, 50, 60)
- SERIES
- TAPE AND REEL 24 = Receptacle

Additional information on this product is available from AVX's catalog or AVX's FAX Service. Call 1-800-879-1613 and request document **#271.** Visit our website http://www.avxcorp.com